Fraser River Estuary
Management Program

Report of The Habitat Activity Work Group

October, 1991

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FRASER RIVER ESTUARY MANAGEMENT PROGRAM

REPORT OF THE HABITAT ACTIVITY WORK GROUP

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EXECUTIVE SUMMARY

The Habitat Activity Work Group (HAWG) was established by the Fraser River Estuary Management Program (FREMP) Management Committee Executive (MCE) to address estuary-wide activities related to habitat management in the FREMP area of the Fraser River estuary. The HAWG was tasked by the MCE with terms of reference that reflected the objectives and component tasks of the FREMP Implementation Strategy (FREMP Review Committee 1984). Habitat inventory, habitat classification, and an expert habitat workshop were the three main activities completed by the HAWG during its four year tenure from 1986 to 1990. With input from agencies participating with the HAWG, habitat activities in the Fraser River estuary were reviewed and analyzed. Areas of concern were identified, conclusions described, and recommendations made on issues related to five habitat discussion topics; namely:

- *Habitat Protection and Conservation*
- *Restoration and Enhancement*
- *Management Plans and Programs*
- *Public Awareness*
- *Workshop Results (Expert Habitat Workshop)*

The following conclusions highlight some of the most relevant aspects of each of the above topics.

In its review of habitat **protection and conservation**, the HAWG concludes that recent applications of the DFO "No Net Loss Fish Management Policy" have substantially improved the protection and conservation of fish habitat. Recent progress in the application of the Environmental Assessment and Review Process (EARP) has also greatly improved the environmental review of federal projects. However, the HAWG concludes that existing environmental legislation is not adequate to protect and conserve all important habitat for fish and wildlife in the Fraser River estuary. Acquisition of key habitat areas, an important element in habitat conservation, has been limited in extent and many critical habitat areas

remain unsecured. Wildlife habitat compensation is currently pursued under regional working guidelines. The establishment of a formal policy would improve the agencies' abilities to protect wildlife habitat.

Habitat **restoration and enhancement** is a major means of providing for the habitat needs of fish and wildlife. A number of successful projects have already been undertaken in the estuary. Restoration and enhancement activities are relatively recent undertakings in the estuary and therefore industry and all levels of government need to be encouraged to become more active participants. Also, an overall habitat restoration and enhancement plan or strategy would offer the necessary guidance for future projects.

The tools for **habitat management plans and programs** such as the previously mentioned habitat classification, habitat inventory, and the Area Designations, provide the means to base development approval and planning in the estuary on sound environmental principles. The HAWG recognizes that these tools have not been adopted and supported by all participants in the FREMP. HAWG expects that the future FREMP will be better supported and that a comprehensive habitat management plan will be developed. Habitat management on lands not currently controlled by wildlife agencies, is largely a reaction to specific development projects, or it involves land acquisitions based on the best existing opportunities. The existing FREMP boundaries assigned to the estuary result in incomplete links in the management of aquatic and terrestrial habitats.

The potential exists to improve **public awareness**, and education concerning habitat in the estuary and habitat-related project proposals. A public interpretive resource facility would offer an accessible overview of information on the Fraser River estuary.

Based on the FREMP habitat **workshop results**, a number of data gaps and uncertainties related to the ecology of the Fraser River estuary were identified. Results of directed research efforts will continue to play an important role in improving our ability to manage the habitat. Habitat-related research funding in the last decade has been quite limited and needs to be improved. Habitat research has had a limited ecological scope. The various agencies engaged in research studies could substantially enhance the ecological database

by coordinating their efforts in the Fraser River estuary.

The following recommendations are considered by the HAWG as being of utmost priority:

Protection and Conservation

- Regulatory means must be developed and coordination and enforcement of existing regulations must be improved to better protect wildlife habitat.

Restoration and Enhancement

- Degraded habitat areas with high potential for restoration must be returned to their former productivity.

- Habitat restoration and enhancement plans must be developed and coordinated by the HAWG successor, which must also ensure that the plans are implemented.

Management Plans and Programs

- Adequate funding and resource commitments from participating agencies at all levels of government is a prerequisite for the proper implementation and success of all future FREMP programs and activities.

- The Habitat Management Plan developed by the HAWG successor and adopted by the future FREMP must be based on the following:

    a) It must be a proactive, estuary-wide plan that takes into account the complete inventory and classification of habitat;

    b) Administrative and working-level linkages must be established with other programs and planning efforts which affect habitats in the estuary;

c) It must tie into regional and municipal land-use the need for natural open areas, wetlands, parks, and agricultural lands which serve as valuable habitat;

d) It must provide for a net gain in the quantity of habitat over time;

e) It must be linked to basin-wide planning.

Public Awareness

- The opportunities for public involvement in the various environmental review processes must be improved by better advertisements of project proposals and by the Environmental Review Committee (ERC) issuing an annual report.

- A network of Environmental Interpretation Centres is needed for the Fraser River estuary.

- A regular meeting must be held at least each year to discuss habitat research, issues, and concerns.

Habitat Research

- Ecological research and management must be undertaken as a cooperative effort amongst the various government agencies, and other groups and organizations, and should include the following:

a) FREMP must have a Standing Committee on Estuary Research to coordinate multi-agency research projects;

b) The habitat dependencies of key fish and wildlife components need to be determined by experimental research;

c) The role of fish and wildlife food organisms as bioindicators of contamination and the functions of marshes and other aquatic plant communities as biofilters must be investigated;

d) New funding for accelerated efforts in ecological research must be considered through such means as the imposition of ecological surcharges on development or other suitable means.

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INTRODUCTION

The Fraser River Estuary Management Program (FREMP) is a cooperative agreement between public agencies to facilitate sustainable development within the FREMP area of the Fraser River estuary (Figure 1). FREMP, established in 1985 was the outcome of studies that pointed out the need for close cooperation between the multitude of agencies having jurisdiction and/or interest, stemming from their mandate, in land-use decisions of the area.

The concept of sustainable development implies the need to maintain the productive capacity of the ecological system that makes the Fraser River estuary all important to fish and wildlife resources and their consumptive and non-consumptive use. Toward that end it is essential that attributes of the physical and biological components of the system, as well as their interrelationships, are adequately understood. That understanding in turn allows for the design of measures necessary to safeguard the protection of the ecosystem and defines the limits to development.

The estuary's fish and wildlife resources depend upon an adequate quantity and quality of habitat. The habitat of an organism can be simply defined as the place where it lives or where it is expected to live. However, habitat is also more than mere physical space. There are numerous functional interactions between the organism and its habitat. These interactions determine how the organism transforms energy (e.g. decomposition, feeding), how it behaves (e.g. predation, mating), how it responds to and modifies its environment (e.g. salinity, sediment quality), and how it interacts (e.g. competition) with other species present in the habitat. Urban, industrial, and agricultural development have a major impact on the habitat of the Fraser River Estuary. Therefore the FREMP recognizes and promotes the understanding of the Fraser Estuary as an integrated biophysical and economic resource.

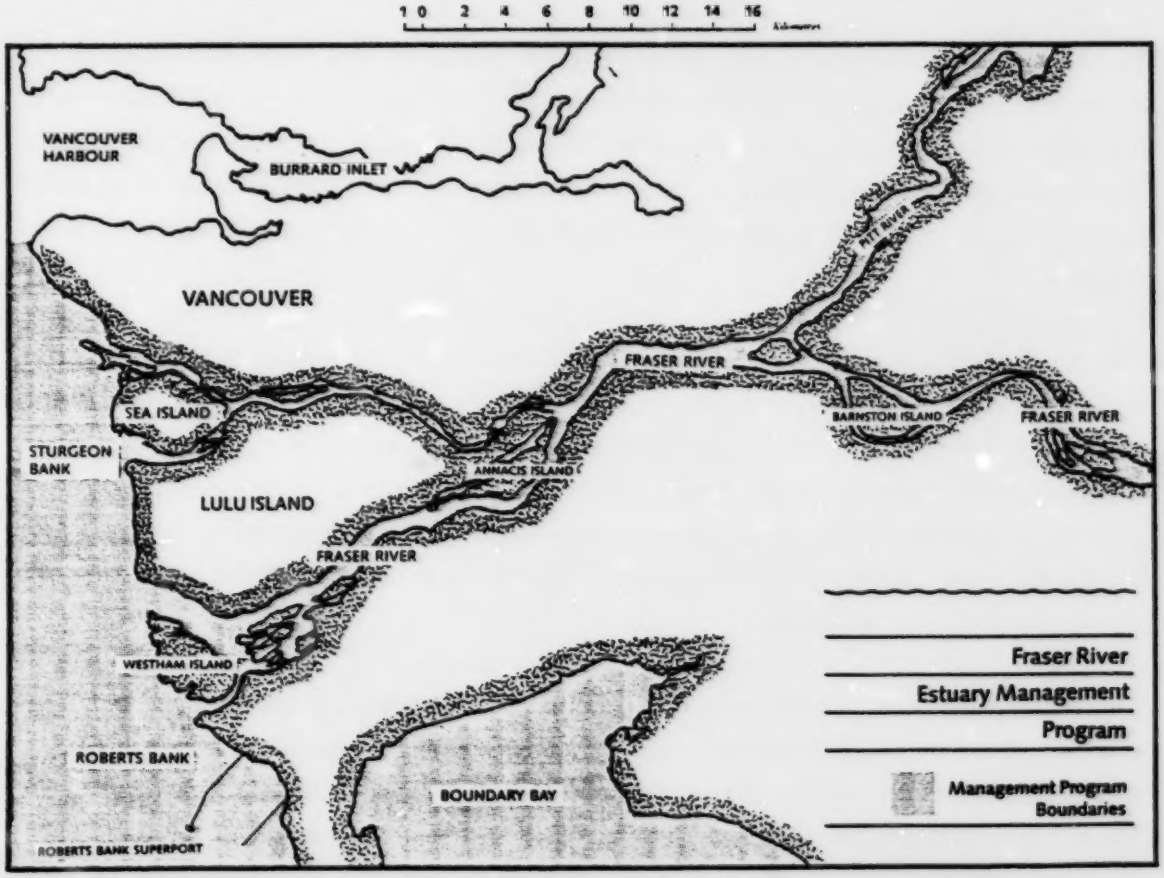

Figure 1. Fraser River estuary and FREMP area.

The FREMP thus set out to review activities within the estuary that bear on the overall objective of sustainable development. It established working groups to investigate aspects of the natural resource and the interaction of industry and others users with these natural resources. One such program activity is the Habitat Management Activity Program (HMAP) carried out by the Habitat Activity Work Group (HAWG). The HAWG was established to address estuary-wide activities related to habitat management.

From its inception in 1985, the DFO, through its chairmanship of the HAWG, has been the designated Agency responsible for heading the Habitat Management Activity Program (HMAP). The HMAP objectives and component tasks as outlined in the FREMP Implementation Strategy (FREMP Review Committee 1984) are as follows:

Objectives

1. To manage fish and wildlife habitats through protection, restoration, enhancement, and research.

2. To encourage better habitat management decision-making by improving the information base on habitat areas, ecological processes occurring in each area, and their significance.

3. To improve the abilities of habitat management agencies to assess the environmental consequences of various activities and measures to avoid or minimize losses.

4. To improve mitigation technologies and develop means to compensate for habitat losses.

Component Tasks

1. Ensure the conservation and management of all Crown owned habitats.

2. Restore habitats currently in a degraded state where it is practical to do so.

3. Develop habitat creation, restoration, and enhancement pilot projects to assess the cost and biophysical effectiveness of various methods.

4. Encourage public enjoyment and appreciation of habitat systems.

5. Develop coordinated programs to:
   a) monitor habitat losses and gains;
   b) survey the effectiveness of mitigation measures during project construction.
   c) fund acquisition and management of priority habitat areas; and,
   d) undertake experimental management and functional relationship research to supplement ongoing ecological work.

6. Integrate policies and practices relating to catch management, hunting, enhancement, habitat protection and water quality.

7. Establish a program to evaluate habitat trade-off proposals, off-site compensation and other measures to ensure habitat gains match habitat losses.

Faced with the broad objectives and component tasks of the FREMP Implementation Strategy, and given the limited funding that was available, the HAWG chose to focus on two specific activities. One of these activities was the Habitat Inventory and Classification. The purpose of this activity was to obtain a comprehensive inventory of the habitat resource and a foreshore classification scheme to assist in directing developers in the estuary. The second activity was an expert Habitat Workshop to provide recommendations on a future direction for habitat research and management.

The HAWG activities were aimed at complementing rather than replacing other ongoing agency activities. Stated objectives/goals of FREMP that were met through related or independent activities of agencies cooperating with the FREMP therefore needed no additional effort from the HAWG.

This report is aimed at giving an overview of matters as they now stand in terms of habitat related activities that were identified in the objectives/tasks of the FREMP Implementation Strategy. The synopsis provides an overview of institutional means such as legislation, policies and guidelines that enables participants to work toward objectives and lists results and achievements towards those objectives. Main information gaps, lack of means to proceed toward certain objectives and significant shortfalls in achievements are also listed. Recommendations to address information gaps, lack of progress and achievements are also given primarily as a result of workshops attended by HAWG members and habitat managers and researchers practicing in the Fraser River Estuary.

A list of definitions for acronyms used in this report is provided in Appendix 1.

PROTECTION AND CONSERVATION

Habitat protection and conservation stems from a variety of federal and provincial legislation. Each environmental statute affords varying degrees of direct or indirect protection for habitat in the Fraser estuary.

Habitat protection is most rigorously and effectively pursued in various environmental review processes. Enforcement of environmental review may result in rejection of development proposals on the grounds that potential habitat losses or impacts are unacceptable. On the other hand, a proposal may be accepted on the proviso that detrimental impacts on habitat are mitigated or compensated.

Habitat compensation is therefore a special condition of project acceptance when all other measures of avoiding or mitigating habitat impacts have failed. Specific habitat compensation procedures have been developed by the DFO based on its working principle of "no net loss".

Finally, where it is feasible, the most effective method of protection and conservation is provided by securing valuable habitat through land acquisition and management.

This report section provides information on habitat protection and conservation in the Fraser estuary in terms of existing government legislation, environmental review processes, land acquisition, and habitat compensation.

1. Government Legislation, Policies, Processes

Much of the current environmental legislation has some direct or indirect effect on the protection and conservation of habitat. A complete and detailed review of environmental legislation is beyond the scope of this report. The main focus of the information provided below is on legislation that has a relatively direct impact on habitat protection and conservation in the Fraser estuary.

1.1 Federal

Information on federal environmental acts is from: DFO (1986), van Hees (1983), and Retfalvi (1989).

1.1.1 Fisheries Act (1977)

The Fisheries Act is administered by the Department of Fisheries and Oceans (DFO) regarding tidal water and waters frequented by anadromous salmon and by the B.C. Ministry of Environment (MOE) regarding waters frequented by anadromous steelhead and resident freshwater species. Under the Fisheries Act, "fish habitats" are defined as those parts of the environment "on which fish depend, directly or indirectly, in order to carry out their life process".

The habitat protection provision of the Fisheries Act provide specific powers and authority (under Sections 36 and 37 of the Act) to protect against developments which are likely to result in the harmful alteration, disruption or destruction of fish habitat. The Department of Environment (DOE) administers the water quality provision of Section 37 of the Act. The Fisheries Act and its habitat protection provision are the backbone of habitat protection in the Fraser River estuary. They are the most frequently used habitat protection legislation used in the estuary.

1.1.1.1 Fish Habitat Management Policy

The DFO's policy for the management of fish habitat is designed to achieve a no net loss of the productive capacity of fish habitat (DFO 1986). Fish habitat is conserved by application and enforcement of the No Net Loss Policy. Restoration and net gains of fish habitat are achieved through restoration and enhancement as described in Chapter II. The objective of achieving a net gain of habitat is supported by three goals covering the conservation, restoration and development of fish habitat. These goals are as follows:

a) Maintain the current productive capacity of fish habitats supporting Canada's fisheries resources, so that fish suitable for human consumption may be produced. (This goal will be implemented using a No Net Loss guiding principle).

b) Rehabilitate the productive capacity of fish habitats in selected areas where economic or social benefits can be achieved through the fisheries resource.

c) Create and improve fish habitats in selected areas where the production of fisheries resources can be increased for the social or economic benefit of Canadians.

1.1.2 Canadian Environmental Protection Act (1988)

The Canadian Environmental Protection Act (CEPA) is administered by Environment Canada (EC). The Act is intended to be used in the formulation of comprehensive environmental pollution control and abatement plans. National Health and Welfare will formulate environmental objectives and guidelines under the Act. The Act will cover toxic pollutants which will be included in a "Priority Substances List". Environmental contaminants which have been added to the "List of Toxic Substances" will be regulated as to their discharge into the environment, manufacture, sale, export and import, etc. A contravention of the Act is subject to prosecution under the Criminal Code. Enactment of CEPA in 1988 has replaced and therefore repealed the Canada Water Act, the Clean Air Act, the Environmental Contaminants Act, and the Ocean Dumping Control Act.

1.1.3 Migratory Birds Convention Act (1917)

The Migratory Birds Convention Act is administered by the Canadian Wildlife Service (CWS) of EC. It implements a convention between Canada and the United States for the protection of migratory birds in the two countries. Under this Act, regulations can be made by the federal Cabinet to ensure the protection of migratory birds which inhabit the estuary during any part, or all, of the year. Section 4(1)(2) of the Act authorizes the protection of migratory birds, and the control and management of "prescribed areas"; however, the Act does not in itself empower the Minister of Environment to acquire or purchase

land for these purposes.

1.1.4 Canada Wildlife Act

The Canada Wildlife Act (CWA), administered by the CWS (EC) allows the federal government to work by itself or in cooperation with other government and private organizations to conserve and manage wildlife and wildlife habitat. The Act provides for involvement in activities related to wildlife management including, disposition of land, and general management of wildlife areas established under this Act. Wildlife areas established under the Act are usually called National Wildlife Areas (see Section 3.5 of this report). The Federal Crown is not required to own the lands it manages under this Act.

1.2 Provincial

1.2.1 Wildlife Act

The Wildlife Act governs the conservation and management of the wildlife resources and wildlife habitat of the province. The Act is administered by the B.C. MOE and provides the following provisions for the protection of habitat:

a) Critical Wildlife Areas (CWA) may be designated from Crown Land by Cabinet for the protection of threatened or endangered species.

b) Wildlife Management Areas (WMA) may be designated from Crown Land by the Minister of Environment under his administration. The only designated WMA in the estuary is the Pitt-Addington Marsh (see Section 3.3).

Under the Act, land for both CWAs and WMAs may be acquired through purchase, lease, donation, expropriation or land transfer. The Habitat Conservation Fund or one or more of a number of other funding sources are used to ensure that the Minister of Environment has funding to a) establish and maintain CWAs and WMAs, and b) enhance fish and wildlife and their habitat in the province. The Crown has the right of action against any person

who, without authority, damages or destroys wildlife or wildlife habitat in a CWA or WMA.

1.2.2 Environmental Management Act

The Environmental Management Act empowers the Minister of Environment to manage, protect and enhance the environment. While this Act does not grant specific powers for the acquisition and protection of habitat, the Act does allow for the preparation of environmental management plans for specific areas of the province which may include measures with respect to wildlife management (MOE 1981). Examples of environmental management plans are given in Chapter III, Section 5.).

1.2.3 Greenbelt Act

The Greenbelt Act provides for the setting aside of crown land or the acquisition of private lands to control land use according to the requirements of municipalities for green and open space. Greenbelt Act funds were used for the provincial share in the purchase of Sturgeon Bank and Ladner Marsh, Cooperative Wildlife Areas (see Section 3.4), and for the purchase of the major part of the Pitt Wildlife Management Area. The Act is administered by the Ministry of Crown Lands, although after acquisition , land may be transferred to another Ministry, such as the MOE. The Act does not specify how land is to be managed; however, specific designation under the Act assures the exclusion of land use that would impair its original qualities.

1.2.4 Archaeological Protection Act

This Act is used to protect and preserve sites of cultural and historic significance to the province. The Act can be used to protect habitat in locations where archaeological and habitat values coincide.

2. Environmental Review Processes

Proposed projects in the Fraser estuary are subjected to the regulatory scrutiny of numerous agencies at each level of government. Each agency has a different perspective, based on its legal responsibilities, of how a proposal relates to habitat in the estuary. Some of the review processes are required by legislation; however, others are purely administrative.

Most of the environmental review processes described below are coordinated and streamlined through the Fraser River Estuary Management Program (FREMP). However, depending on the nature of the environmental issue that is under review, a specific environmental review process may dominate.

The following information will focus only on those review processes that are relevant to habitat protection in the Fraser estuary. The information presented is largely from Andrews and Higham (1986), updated where necessary through personal communications with respective government department representatives.

2.1 Federal

2.1.1 Environment Canada Referral System

The environmental review of proposals by EC, the DFO, and other federal departments is facilitated by the EC coordinated referral system. Much of the coordination within the Fraser River estuary is now undertaken by FREMP. All federal projects are subject to review according to the EARP Guidelines Order (see below). The length of the review and the fate of the project is determined by the amount of information known about a proposed project and the significance of predicted impacts.

2.1.2 Environmental Assessment and Review Process

The Environmental Assessment and Review Process (EARP) is the major federal mechanism for environmental assessment. Its goal is to ensure that environmental implications of

all proposals for which the federal government has a decision-making responsibility are fully considered as early in the planning process as possible and before irrevocable decisions are made.

Two recent examples of proposals involving the EARP are the Fuel Barge Loading Facility and Vancouver International Airport Expansion. The EARP process may be applied to proposals for the following four reasons:

a) The proposals are undertaken by a federal department.

b) They have environmental effects on an area of federal responsibility.

c) The federal government has a financial commitment to the proposed projects.

d) The proposed project is located on land administered by the federal government.

There are two basic phases within EARP: initial assessment and public review by an EARP Panel. For most projects, the initial assessment phase is all that is required. In these cases, the environmental impacts can be mitigated with existing technology and the project may therefore proceed. In some cases the impacts are significant and/or can not be mitigated, or the public concern is so great that the project must proceed to a panel review.

EARP is administered by the Federal Environmental Assessment Review Office (FEARO). FEARO is separate from Environment Canada and reports directly to the Minister of the Environment. It assists federal departments with initial assessments and furnishes advice and procedural guidelines.

2.1.3 Environmental Contaminants

Environment Canada (EC) and National Health and Welfare Canada (NHWC) are jointly responsible for assessing and regulating environmental contaminants under the Canadian Environmental Protection Act. The Act's provisions for regulation of environmental

contaminants apply to substances that enter the environment in quantities or concentrations or under conditions that may constitute a danger to human health or the environment. Review of a suspect substance covers any aspect of production, use and disposal. The Act applies where controls under other federal and provincial legislation are insufficient.

Environmental Protection administers the act, and assesses the ecological and environmental impacts of chemicals. Recently, the presence of chlorophenols and dioxins in the estuary have been under intense review.

2.1.4 Fisheries

The Minister of Fisheries and Oceans is responsible for approval of any project that might have a negative impact on fish or fish habitat under the Fisheries Act. The Act authorizes the Minister or someone delegated by him to order modifications or, with Cabinet approval, closure of any project that is likely to result in harm to fish habitat or the deposit of a "substance deleterious to fish" into "waters frequented by fish". The DFO has assigned to EC the administrative responsibility for projects which may result in the deposition of substances harmful to fish or fish habitat, by a Memorandum of Understanding between the two departments.

DFO's review of projects focuses on the protection of fish and fish habitat. DFO policy is not to allow damage to fish habitat except, in certain cases, where "no net loss of productive capacity" of fish habitat can be achieved: that is, where fish habitat damaged by a project can be compensated for by enhanced or newly created fish habitat nearby.

2.1.5 Navigable Waters

Projects that include any works in, upon, over, under, through or across navigable waters must be approved by Transport Canada under the Navigable Waters Protection Act (NWPA). Review of an application for NWPA approval focuses exclusively on interference with the public right of navigation. Environmental concerns are dealt with only to the

extent that they constitute an interference with the public right of navigation. NWPA review is administered by the Navigable Waters Protection Act Programs Division, Canadian Coast Guard, Transport Canada.

2.1.6 Ocean Dumping

Environment Canada (EC) is responsible for approving projects that involve dumping material at sea under Part VI of the Canadian Environmental Protection Act. EC administers the ocean dumping review process under the authority of the Fisheries Act to the extent that dumping may affect the fisheries. There are no official ocean dumping sites within the FREMP boundaries of the estuary. However, in reviewing and application for an ocean dumping permit, several considerations are relevant to habitat within the FREMP area, especially if dredged material is involved:

a) the physical, chemical, biochemical and biological properties of the substance and its susceptibility to change in the aquatic environment.

b) the amount, toxicity, persistence and bioaccumulation potential of the substance.

c) possible effects on marine life.

2.2 Provincial

2.2.1 Crown Land

The Land Disposition Referral Procedure is the main Crown Land review process. It is administered by the Ministry of Crown Lands under the Land Act. The Land Disposition Referral Procedure applies to applications for new and replacement land tenures as well as to proposals for reserves, designations and notations under the Land Act. It applies to all B.C. Crown Land including non-forest uses on Crown Land designated by Cabinet as Provincial Forest under the Forest Act.

The purpose of the Land Disposition Referral Procedure is to obtain the highest and best use of Crown land, to achieve interagency cooperation and to minimize conflicts between resource development and environmental protection.

Requests for Section 101 Transfer of Administration and Control are made to the Senior Land Officer with the Ministry of Crown Lands. A number of Section 101 applications have been made by the Ministry of Environment for the purpose of securing biologically important habitat in the estuary. These land acquisitions will be discussed in greater detail in Section 3.0 of this report.

2.2.2 Energy Projects

The Utilities Commission Act is the statutory authority for the Energy Project Review Process in which the Minister of Energy, Mines and Petroleum Resources, with the help of the B.C. Utilities Commission, is responsible for the review of major energy projects ("regulated projects"). The precise scope of a review under the Energy Project Review Process is defined by terms of reference specified jointly by the Minister of Energy, Mines and Petroleum Resources and the Minister of Environment. Generally, the review encompasses energy, economic, social, land use, resource and environmental issues.

In the early 1980's, the B.C. Utilities Commission held hearings to review the application made by B.C. Hydro Gas Group for a gas pipeline to Vancouver Island that would require a routing through the Fraser estuary.

2.2.3 Floodplains

The Ministry of Environment exercises broad responsibility regarding flooding and floodplains under the Ministry of Environment Act. Under the Water Act, the floodplain review process can also apply to applications to deliberately flood Crown Land. This would be the case where an applicant may wish to convert dyked land to a flooded area in order to create aquatic habitat. MOE's Water Management Branch administers the Ministry's floodplain responsibilities.

2.2.4 Major Project Review

The following information was taken from the Major Project Review Process Guidelines (Ministry of Regional and Economic Development and MOE 1989).

The Major Project Review Process (MPRP) was established to provide for the comprehensive and timely assessment of the environmental and socioeconomic impacts of projects not examined under existing integrated review processes. The MPRP will not replace existing integrated review processes. It will apply to those major projects not currently subject to these processes. Generally these types of projects fall into four main categories: pulp and paper, mineral smelting and refining, chemical production, and major ports and marinas. The Cabinet Committee on Sustainable Development reserves the right to judge which projects will ultimately be required to go through the MPRP.

The MPRP is a non-legislated working policy supported by the Environment and Land Use Act. It is administered by the Major Project Steering Committee, co-chaired by the Ministry of Regional and Economic Development and the MOE. the Steering Committee includes representatives from the Ministry of Forests, Energy, Mines and Petroleum Resources, Municipal Affairs, Recreation and Culture, as well as Environment Canada and the FEARO. The federal representatives will provide advice on whether a project under review can be classified as a "proposal" as defined in the EARP Order-in-Council, and suggest ways to meet the EARP requirements.

2.2.5 Order-in-Council 908

The Fraser River Estuary Environmental Impact Assessment Guidelines implement Order-in-Council 908/77 approved by Cabinet under the authority of the Environment and Land Use Act. OIC 908 applies to all proposed developments outside the dykes in Sturgeon and Roberts Banks and in Boundary and Semiahmoo Bays. Every proposed development in the area is subject to a mandatory environmental impact assessment prepared by the proponent. The Lower Mainland Regional Environmental Coordinator of the Ministry of Environment administers OIC 908 under the auspices of the Deputy Minis-

ter of MOE.

2.2.6 Pesticides

The MOE is responsible for approving the sale or use of pesticides under the Pesticide Control Act. MOE's authority applies only to the use of pesticides listed on Schedule I and II of the Pesticide Control Act. Review of an application is limited to whether the proposed application would cause an unreasonable adverse effect.

2.2.7 Wastes

The MOE is responsible for regulation of the discharge of waste into the environment under the Waste Management Act, and the Ministry of Environment Act. The purpose and function of MOE in administering its waste discharge approval process is: a) to encourage and maintain an optimum quality environment, and b) to manage, protect, and conserve all water, land, air, plant life, and animal life, having regard to the economic and social benefits they confer on the Province.

2.3 Joint Federal-Provincial

2.3.1 FREMP Coordinated Project Review Process

The FREMP Coordinated Project Review Process was established to ensure that all development proposals within the FREMP boundaries are subject to an environmental review. These boundaries include the land and water area outside of the dykes, between Kanaka Creek and the outlet of Pitt Lake in the east, the estuary drop-off in the west, Point Grey to the north, and the U.S. border to the south including Boundary Bay and Semiahmoo Bay (Figure 1).

The process requires that a developer (proponent) submit a standard application form to one of three lead agencies (depending upon the location of the project): the Fraser River Harbour Commission, North Fraser Harbour Commission or Ministry of Crown Lands.

The lead agency forwards the application form to the FREMP Secretariat office where it is sent to the relevant review agencies including provincial and federal environmental agencies and the municipality. The application is entered into the Central Project Registry at the Secretariat office where it is available for public review. The review agencies have thirty days to submit their comments to the Secretariat office.

An Environmental Review Committee (ERC) comprised of representatives from Environment Canada, the B.C. MOE, and DFO meets bi-weekly to: i) review the comments of the various environmental agencies; ii) advise the Lead Agency of any environmental concerns relating to the project proposals; and iii) determine if further environmental review is required for the proposal (i.e. Level 2 or Level 3 Review, described below).

The above describes the review process for the majority of projects which typically involve inter-agency referrals. For some proposed projects in the Fraser estuary a more intensive review may be required. This could involve the filing of an environmental impact assessment by the proponent. The decision to elevate a project to a higher level of review is done by the ERC in consultation with the Lead Agency and Management Committee Executive of FREMP. These groups will determine whether or not a project can be reviewed adequately with available information and will discuss what additional information appears necessary. Where other review procedures apply to a particular project, duplication of analysis is avoided. An inter-agency task force can be formed to deal more intensively with a particular project (Level 2 Review).

For those projects which fall under the auspices of an established review process, e.g. Federal Environmental and Assessment Review Process, B.C. Major Project Review, etc., the ERC and Lead Agency will refer the application to the respective review process. This level of review (Level 3) may involve a specially constituted review panel and public hearings.

3. Habitat Acquisition and Management

One of the most desirable and effective habitat conservation measures is for environmental agencies or conservation groups to acquire and secure control over valuable habitat areas. The method for acquiring critical habitat areas in the Fraser River estuary has been to purchase land directly, transfer land title, or to receive control over land management.

Direct acquisition of vital habitat is the most secure form of habitat protection as compared to zoning and land-use planning because it usually avoids any potential future conflicts over land use and development.

A number of key habitat areas have been identified by the provincial government for future acquisition. Appendix 2 provides a listing of existing and desired land acquisitions representing important habitat areas in the estuary. Appendix 2 does not represent a comprehensive or prioritized listing of preferred habitat acquisitions.

3.1 Purchase of Land Title

Large land purchases are expensive and such acquisitions are therefore usually undertaken jointly by several agencies and organizations through cooperative conservation programs.

The Habitat Conservation Fund (HCF) was established by the provincial government in 1981 to secure and enhance habitat for fish and wildlife. The Fund provides independent financing to be applied directly to habitat conservation and improvement. The primary source of revenue is a surcharge on all hunting, fishing, trapping and guiding licences sold in B.C.. Further funding is provided from compensation payments, and donations and bequests. Projects proposed for Fund support are reviewed by MOE technical staff, and by a Public Advisory Board. Through this fund, money is raised and allocated to habitat acquisition and enhancement.

The Pacific Estuary Conservation Program (PECP) stems from an agreement between three prominent conservation organizations and four government agencies: The Nature

Trust of B.C., Wildlife Habitat Canada, and Ducks Unlimited Canada, the B.C. Ministry of Environment, Ministry of Crown Lands, the Canadian Wildlife Service, and the federal Department of Fisheries and Oceans. The Program works to conserve and restore critical estuaries, especially coastal wetlands that provide habitat for waterfowl and fish populations.

A recent example of the purchase of habitat under the PECP was the acquisition of Kirkland and Rose Island. This 112 ha property of dyked floodplain was a privately owned component of the 760 ha South Arm marshes complex. The Ministry of Environment will manage the property under a 99-year lease from The Nature Trust of B.C. which now holds title to the island.

Another recent acquisition under the PECP was Harlock Island, a small tidal island adjoining the federally owned lands of Alaksen National Wildlife Area. Harlock Island has been leased to the CWS for management.

Land purchased for the purpose of municipal or regional parks is another example of habitat conservation through land acquisition. The recent purchase of Kanaka Creek mouth by GVRD Parks and Purfleet Point (south end of Annacis Island) by Delta Parks and Recreation are two examples of the acquisition of valuable habitat by local governments.

Riparian habitat has been set aside for protection in the joint federal-provincial Fraser River Dyking Program. In the Pitt Meadows dyking and pump station construction project, a tree and shrub belt was protected in its natural state to meet the sustainability of the riverine and foreshore environment.

The Pacific Coast Joint Venture under the North American Waterfowl Management Plan (NAWMP) is a major recent initiative designed to buy up nearly $500-million worth of threatened waterfowl habitat along the Middle-Upper Pacific coast. Table 1 shows the status and needs for securing waterfowl habitat in the Fraser estuary according to the NAWMP Pacific Coast Habitat Prospectus (NAWMP 1990).

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TABLE 1. Status and needs for securing waterfowl habitat in the Fraser estuary according to the North American Waterfowl Management Plan.

Wetland Area	Unit Size hectares	Habitat Secured	Additional Habitat Needed Crown	Private
Boundary/				
Mud Bay	**33,427**	360		
Foreshore	9,956		9,956	
Upland	23,471			5,139
Roberts Bank	**16,673**	554		
Foreshore	11,736		11,533	
Upland	4,937			3,683
Sturgeon Bank	**7,932**			
Foreshore	7,932	132	7,699	101
Upland	irreversibly lost			
South Arm				
Marshes	**898**			
Foreshore	728	132	597	
Upland	170			170
Pitt Complex	**7,790**			
Pitt WMA	2,995	2,995		
Widgeon Sl.	708	130		587
Douglas Is.	182			182
Uplands	3,905			1,012
Total Area	66,720	4,303	29,785	10,874
Percentage of Total	100%	6%	45%	16%

The Joint Venture Management Board will be co-chaired by the Canadian Wildlife Service and the U.S. Fish and Wildlife Service.

3.2 Transfer of Land Title or Control

Transfer of land title and administrative control is typically undertaken between government agencies or when land is donated to an agency or organization by the land owner. Under Section 101 of the Provincial Land Act, administrative control of Crown Land can be transferred from one Ministry to another. This type of land management transfer requires cabinet approval by an Order-in-Council. Several important habitat areas have already been acquired from Crown Lands by the B.C. Ministry of Environment. These areas include Grauer Beach in Boundary Bay, part of Ladner Marsh, and the Pitt/Addington marshes. A number of additional habitat areas are under Section 101 application and others have been identified for future application (see Appendix 2).

3.3 Wildlife Management Areas

The ultimate aim of land acquisition programs under the B.C. Ministry of Environment is to create Wildlife Management Areas for important habitat areas in the estuary (see Appendix 2). According to the data (Table 1) presented by the North American Waterfowl Management Plan, only 6% of the existing habitat in the Fraser River estuary is secured. Wildlife Management Area status would facilitate the coordinated development of specific management plans with the cooperation of other government agencies as well as private conservation groups.

To date the only designated Wildlife Management Area in the Fraser estuary is the Pitt Wildlife Management Area (PWMA). The PWMA has a long history of land acquisition and development dating back to 1958. There are currently five marsh areas in the PWMA (Katzie Marsh, Pitt Marsh, Homilkum Marsh, Munmunta Basin, Crane Reserve); comprising a total area of 1028 ha.

3.4 Cooperative Wildlife Areas

Federal-Provincial Agreements in 1978 and 1980 led to the acquisition and joint wildlife management of tidal wetlands at Sturgeon Bank and Ladner Marsh. Under the terms of the Agreement, the acquired lands are to be managed jointly by the CWS and MOE as a Cooperative Wildlife Area (CWA). Title of the lands is held provincially by the MOE. Both the Sturgeon Bank CWA and the Ladner Marsh CWA are to be designated and thus

protected under both the Canada Wildlife Act and the B.C. Wildlife Act. Draft management plans call for the maintenance of natural conditions and for possible enhancement of the highly productive vegetative community.

3.5 National Wildlife Areas

The Canada Wildlife Act empowers the federal Minister of Environment to acquire land for the conservation, interpretation and research of migratory birds, or with the agreement of the province of B.C., other wildlife. Such an area is usually called a "National Wildlife Area" (NWA). These areas are established through an Order-in-Council, and boundaries can be modified or dissolved through an Order-in-Council as well. There are three NWAs in the Fraser estuary: the Alaksen NWA on the north end of Westham Island, the Widgeon Valley NWA near the outlet of Pitt Lake, and Boundary Bay south of Boundary Bay Airport (Retfalvi 1986a).

3.6 Migratory Bird Sanctuary

A migratory Bird Sanctuary is an area reserved for the purpose of protecting migratory birds and the habitat they use, from disturbance of any kind. A sanctuary is established by a federal Order-in-Council pursuant to the Migratory Bird Sanctuary Regulations. These sanctuary regulations govern activities which are restricted or prohibited within the sanctuary. The only bird sanctuary in the estuary is the George C. Reifel sanctuary at the northern end of Westham Island (Retfalvi 1986b).

4. Habitat Compensation

4.1 Fish Habitat

When habitat in the Fraser River estuary is put at risk by a proposed development project or activity, the first preference is always to try and maintain the natural productive capacity of the habitat by avoiding any loss or harmful alteration. This may be achieved by encouraging the proponent to redesign the project, to select an alternate site, or to mitigate potential damage using other reliable techniques.

Avoidance of any habitat loss or damaging impact is a prerequisite for those areas of the estuary that have been classified as highly productive (see Chapter 3, Section 2.).

Only after it proves impossible or impractical to maintain the same level of habitat pro-

ductive capacity (and in those habitat areas classified as moderate to least productive) would habitat compensation be considered. Based on the DFO habitat policy, the following working principles are adhered to with respect to fish habitat:

a) habitat replacement should be "like-for-like". That is, sedge marsh is replaced with sedge marsh, mudflat with mudflat, and so on. In certain circumstances mudflat can be replaced with marsh if the overall habitat value will increase;

b) habitat replacement should be at or near the site of impact;

c) as a secondary measure, it might be possible to undertake off-site habitat replacement or to increase the productive capacity of existing habitat for the affected stock, if reliable techniques are available.

The habitat replacement formula applied by the DFO to the Fraser River estuary is as follows:

a) For **marsh habitat** the compensation ratio is **2:1** such that twice as much habitat is replaced as is lost or damaged. This replacement ratio was derived by taking into account the time period required for a productive marsh to develop and the risk involved in successfully achieving this goal.

b) For **mudflat and riparian habitat** the compensation ratio is **1:1** such that the same amount of habitat lost or damaged is replaced.

According to the DFO, compensation options will not be possible as a means of dealing with chemical pollution and contamination problems; reliable control techniques must be installed and operated to mitigate such problems from the outset. The FREMP Waste Management Activity Program has addressed chemical pollution problems by recommending pollution abatement options, education and public awareness, and various administrative strategies designed to curb pollution in the estuary (FREMP Waste Management Activity Work Group 1990).

Some of the positive gains of habitat compensation in the estuary have been stated by Langer (1989) as follows:

1. With predetermined habitat values, developers are discouraged from disproving the habitat value of an area and instead focus their attention on mitigation and com-

pensation work.

2. The risks and losses from the creation of replacement habitat can be addressed by applying compensation ratios greater than 1:1 and follow-up long term monitoring and agreements with the proponent to ensure they carry out remedial measures.

3. Compensation habitat can also be pre-built prior to any losses. The concept of habitat banking fits well into this need.

4.2 Wildlife Habitat

Compensation for wildlife habitat losses due to development in the Fraser River estuary are substantially satisfied by habitat compensation persuant to the DFO policy, inasmuch as habitat for fisheries purposes serves wildlife needs as well. In general, the CWS and MOE require that, at minimum, one half of any important wildlife habitat that is at risk by a proposed development project or activity be retained in a natural state and be placed into secure tenure for conservation. Tenure can be achieved by, for example, turning the land over to the Crown or a conservation organization such as the Nature Trust for the purpose of wildlife management. The implication of this compensation practice is that when habitat is put at risk, only one half is protected. No net loss or full protection of the habitat is therefore not possible.

4.3 Habitat Conservation Fund

One of the three accounts under the HCF is the Compensation Account. This account accepts money from corporations and individuals as compensation for loss or degradation of fish or wildlife habitat due to detrimental impacts from development. The proceeds are used to acquire and/or enhance other habitats near the site where the development occurred (HCF 1988).

4.4 Habitat Banking

Habitat Banking is the practice of creating and saving (banking) new habitat in the estuary for the purpose of future habitat compensation needs. These habitat credits may be made available to qualified developers to compensate for unavoidable habitat losses resulting from industrial or commercial development.

Habitat from the compensation bank may be used as bank withdrawals on a minimum of a 1 to 1 basis when it has been shown that the newly developed habitats are stable and that biological communities are successfully established. If habitats are to be used for compensation before they are stable and fully productive, those habitats will not be considered as coming from the bank on a 1 to 1 basis and instead established DFO compensation ratios will apply (see 4.1 above).

Habitat banking has been established as part of the Environmental Management Plans of the North Fraser Harbour Commission and the Fraser River Harbour Commission (see Chapter IV, Section 4.). Both of the Harbour Commissions will be responsible for general administration of their habitat bank under the technical direction and assistance of the DFO and the other environmental agencies in the Environmental Review Committee.

4.5 Examples of Compensation Projects

Several examples of habitat compensation projects are described to provide a perspective on the current status of habitat compensation in the estuary. Habitat compensation projects can be described under several broad categories depending on the nature of the development project and activity. Thus, habitat compensation features have been incorporated into dyke structures (marsh bench), and onto excavated intertidal basins and dredged material fill. Unvegetated tidal flats have also been planted with vegetation to create new habitat. Examples for each of these approaches are provided below. Figure 2 shows the location of habitat compensation sites in the Fraser estuary.

4.5.1 Use of Dykes (e.g. Bench Marshes)

Several development projects requiring new or restored dykes and rip-rap have been designed to include on-site habitat compensation. Bench marshes have been successfully applied to dykes and rip-rap. A bench marsh is created when the rock slope of the dyke or rip-rap is simply interrupted by a level section located in the intertidal zone. This level area is filled with soil and planted with tidal marsh species. The following habitat compensation projects represent bench marshes.

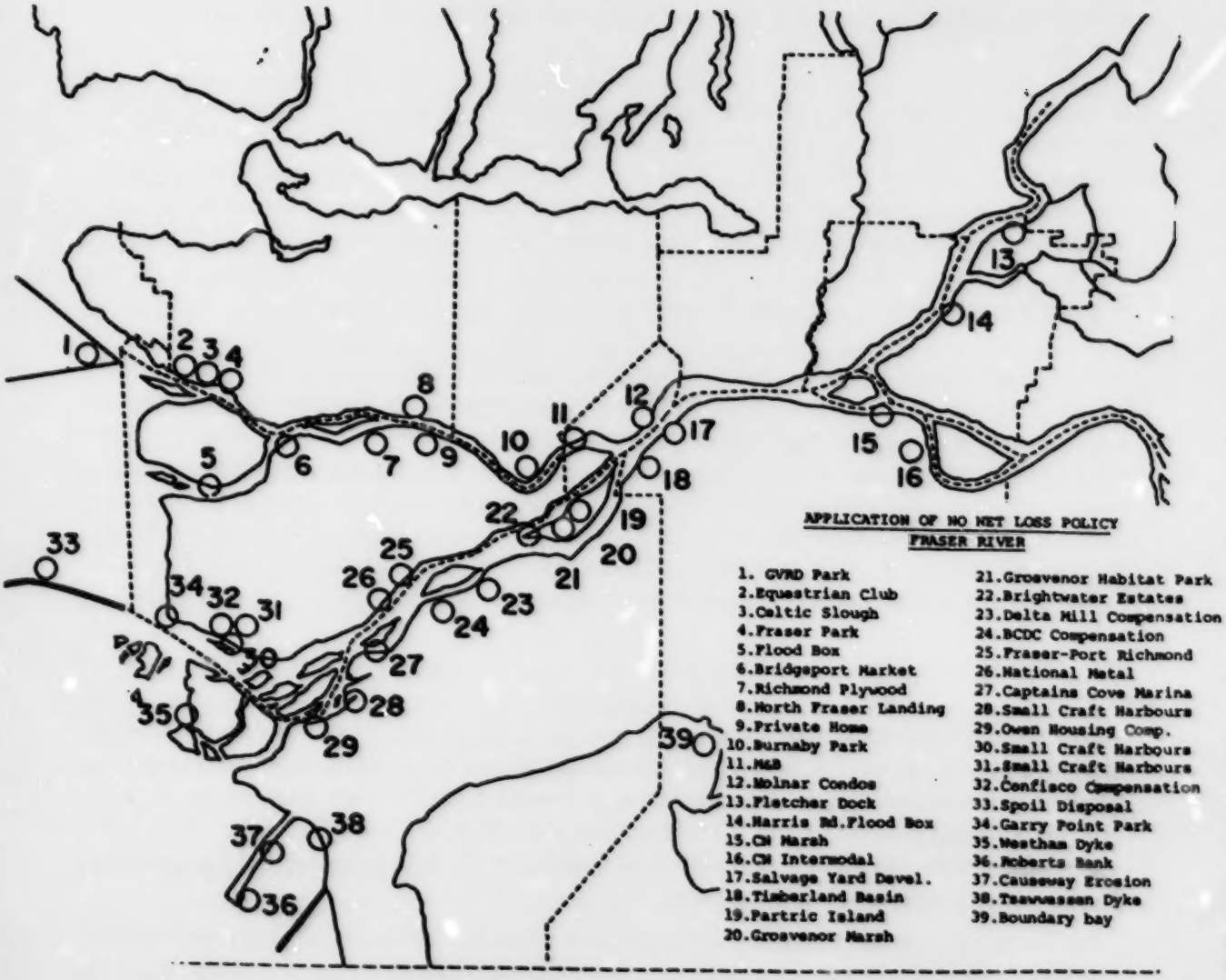

Figure 2. Map of habitat compensation sites (DFO files 1990).

Chung Chuck Property: Completed in 1990, this habitat compensation is located at what is now called the Riverwest Waterfront Condominiums in Ladner. The bench marsh (ca. 1.5 m by 145 m) was incorporated into a newly constructed dyke. The bench was planted with locally acquired sedge vegetation.

New Westminster: An intertidal bench (ca. 2.0 m by 25 m) was incorporated into a constructed dyke at the New Westminster waterfront development. The bench was planted with intertidal marsh vegetation in 1988.

4.5.2 Excavations

In situations where development projects result in opportunities to remove fill near the river shoreline, creation of new intertidal or subtidal habitat may be possible. Ideally this type of habitat compensation should be undertaken at sites where habitat has been filled in the past; of which there are numerous examples in the estuary. The following projects represent examples of habitat creation through excavation.

Patrick Island: As part of the Annacis Crossing Project (Ministry of Transportation and Highways) Patrick Island (north end of Annacis Island) was used for a habitat compensation site. A 2.25 ha subtidal basin was excavated out of the river bank. The intertidal slopes were vegetated with sedge and bulrush vegetation.

Eburne Sawmill: In compensation for a development project undertaken at the Canadian Forest Products Ltd., Eburne Saw Mill Division, a habitat compensation site was chosen at the downstream end of Richmond Island (North Arm). An intertidal area of 4,053 m^2 was created in 1988 by removing approximately 20,000 m^3 of fill associated with an old dump. The newly created intertidal zone was planted with marsh vegetation in 1989.

4.5.3 Filling

Filling in of existing intertidal habitat is generally unacceptable. However, at certain sites, there may be an opportunity to raise sub-tidal elevations in order to provide intertidal habitat. Dredged sand is a typical material source in the estuary. The following is an example of a compensation project involving dredged material fill.

Mitchell Island:

A 1.54 ha marsh was created on the south shore of Mitchell Island to compensate for losses of marsh habitat associated with the Bridgepoint Harbour Market Development. Approximately 100,000 m^3 of dredged sand was used to raise the intertidal elevation at Mitchell Island to the critical levels found at the Bridgepoint site. Several marsh plant communities were transplanted in 1987.

4.5.4 Use of Existing Tidal Flats

In special situations, habitat compensation is feasible on existing intertidal or shallow subtidal areas without any physical alteration. In such cases, the overall productivity of the substrate is increased through planting of aquatic vegetation. Roberts Bank is one area where existing tidal flats have been used for habitat compensation.

Roberts Bank Port Expansion: Roughly 33% (95 ha) of the eelgrass present in the intercauseway area of Roberts Bank in 1967 has been lost as a direct or indirect result of port construction. A variety of experimental eelgrass transplanting techniques were used at Roberts Bank. The Roberts Bank Environmental Review Committee directed these transplanting trials, undertaken by Dr. P.G. Harrison, Department of Botany, UBC, to help in the design of compensation measures. Actual compensation measures have yet to be implemented.

5. Conclusions and Recommendations

Recommendations indicated in ***italics*** are considered by the HAWG to be priority items.

5.1 Government Legislation, Policies, Processes

5.1.1 Conclusions

- The existing environmental legislation that is used to protect and conserve habitat in the Fraser River estuary does not adequately cover all of the important components of the ecosystem. The legislation is disjointed and fragmented, providing protection and conservation for fish, yet often missing wildlife.

- Environmental statutes remain essentially reactive in nature. There is little opportunity for proactive implementation.

- The rights of private ownership is a major obstacle for the development of "wildlife habitat and ecosystem" oriented legislation.

5.1.2 Recommendations

- *Regulatory means must be developed and coordination and enforcement of existing regulations must be improved to better protect wildlife habitat. This legislation must also recognize the interdependency of all living resources in the estuary such that the entire ecosystem is protected and not just individual parts. This can be achieved if all levels of government, through the future standing committee of the integrated FREMP, create new regulatory means and improve the joint coordination and enforcement of existing regulations concerning habitat management.*

- Planning for protection and conservation must be more adequately reflected in the environmental legislation. There could, for example, be property tax incentives offered to protect valuable habitat. Municipalities must be given active participation in this process.

5.2 Environmental Review Processes

5.2.1 Conclusions

- Generally, the overall environmental review process is doing an adequate job of addressing habitat issues in the Fraser River estuary. However, the HAWG recognized that opportunities for public involvement in environmental reviews are inadequate. The involvement of municipal levels of government is also inadequate.

5.2.2 Recommendations

- The MCE must undertake to obtain the response of municipalities to all development proposals within the FREMP boundaries and to file these responses with the Central Project Registry.

5.3 Habitat Acquisition and Management

5.3.1 Conclusions

- The acquisition of important habitat areas has been limited in extent and as a result critical habitat areas remain unsecured. Habitat acquisition represents a key but small component of overall habitat compensation.

5.3.2 Recommendations

- A priority of the HAWG successor must be the development of a centralized and comprehensive inventory of potential habitat acquisition sites for the entire FREMP area. Land acquisition will need to be based on cooperative and proactive planning by all of the environmental agencies and non-government organizations concerned with habitat protection and conservation.

5.4 Habitat Compensation

5.4.1 Conclusions

- Wildlife habitat compensation is currently pursued under a regional working guideline. The establishment of a formal policy would improve the agencies' abilities to protect wildlife habitat.

- There is no comprehensive inventory of compensation projects. There is also very little follow-up and monitoring data available on compensation projects. Therefore, there is a lack of understanding about the effectiveness of existing habitat compensation techniques.

- The HAWG believes that the erosion of ribbon marshes along the river bank is a problem.

5.4.2 Recommendations

- The current working guideline must be enunciated into a formal wildlife habitat compensation policy. The MCE should encourage EC and the B.C. MOE to develop and implement a policy that complements the DFO national habitat policy.

- A comprehensive inventory of the existing compensation projects must be undertaken by the HAWG successor. This information should then be analyzed to determine the present status of habitat compensation in the estuary and to make recommendations on future improvements to compensation techniques and guidelines.

- The problem of bank erosion and habitat loss needs to be examined in detail. The scope and causes of the problem needs to be examined by the HAWG successor. If necessary, remedial action has to be taken by the appropriate agency.

RESTORATION AND ENHANCEMENT

The means and procedures used to protect and conserve habitat in the Fraser estuary, as discussed in Chapter I, are intended to prevent the further loss and degradation of the remaining important habitat areas. To achieve an actual increase in the quantity and quality of fish and wildlife habitat in the Fraser estuary, various restoration and enhancement efforts need to be undertaken.

1. Objectives and Rationale

The principal objective of habitat restoration and enhancement is to increase or improve the capability of the habitat to produce fish and wildlife populations. This objective is primarily directed toward degraded habitat sites. To achieve this objective, restoration and enhancement efforts focus primarily on critical life history requirements of key fish and wildlife species in the estuary.

Outmigrating juvenile salmonids, especially chum and chinook salmon, are strongly dependent on the productive marsh and backchannel habitats of the estuary. These habitats are especially important for feeding and rearing juvenile salmon prior to their migration into the marine environment.

Migrating and overwintering birds depend on the estuarine tidal flats and wetlands for feeding. For example, winter feeding snow goose populations feed on the belowground rhizomes of bulrush in the brackish marshes of the estuary. The mud and sandflats are used by the largest numbers of shorebirds on the British Columbia coast (Butler 1987).

Habitat restoration and enhancement attempts to manipulate those habitat features that are most important in sustaining the critical life history requirements of the key fish and wildlife species of the estuary.

2. Techniques

Water, soil, and vegetation are three fundamental components of the habitat which can be manipulated in restoration and enhancement efforts.

2.1 Water

In some situations, altering the spatial and temporal distribution of water has reestablished conditions more conducive to wetland habitat. Restoration and enhancement projects that affect the quantity of water have mainly attempted to reverse the historical trend of wetland draining and dyking. Thus, there are a few examples in the estuary where conditions of flooding have been restored in previously dyked land such as at Tilbury Slough.

Improving water quality conditions in the Fraser estuary for the direct objective of restoring or enhancing habitat is essentially untested. Effluent and ambient water quality conditions are regulated for the sole purpose of protecting aquatic life, human health, and agricultural, industrial, and recreational water users.

2.2 Soil

Manipulations of soil or edaphic conditions have mainly been undertaken in areas of the estuary supporting little or no significant intertidal habitat. The need for disposal sites for dredged material has been a driving force behind the concept of creating substrate suitable for the development of new marsh habitat in the estuary. The creation of new substrate has also been a technique employed in habitat compensation projects as discussed in Chapter I, Section 4.5.3.

2.3 Vegetation

The most common restoration and enhancement technique involving vegetation has been to obtain rooted wetland plants from existing habitats (so called donor sites) and to transplant this vegetation into a receptor site. This has also been the common practice for habitat compensation projects.

Vegetation can also be indirectly manipulated by increasing the degree of flooding, vegetation communities will naturally shift to an assemblage of species adapted to more aquatic conditions.

The vegetation community can also be altered by cultivating certain species of plants that are most beneficial to particular wildlife species. Such has been the practice on the agricultural land of the Alaksen National Wildlife Area where winter crops are planted to feed migratory waterfowl.

Even simple efforts such as cleaning sites of debris will provide more space for plant growth and result in less impact from floating logs. These sites must then be protected from further degradation by using debris deflectors such as shear booms.

3. Activities

Examples of restoration and enhancement activities in the Fraser estuary are presented below according to the type of technique used, as described above. One or more representative examples of specific projects or efforts by government agencies and conservation groups are also given.

3.1 Site Clean-up

Many potentially productive habitat sites in the estuary are smothered with debris that is relatively easy to remove. Aside from the usual array of discarded refuse of metal, concrete, and plastic, the most common type of debris are logs and other driftwood. This wood

debris grinds up and down over the intertidal vegetation with the movement of the tide and the action of waves. In areas where large amounts of debris accumulates, the vegetation is smothered and primary production may be significantly reduced. The following are some examples of effective site clean-up projects in the estuary.

3.1.1 Boundary Bay Log Removal Project

Boundary Bay foreshore at Grauer Beach (between 64th and 72nd Street) consisted of a 34 ha expanse of driftwood which had over time accumulated into a dense, thick layer. Removal of this log debris was initiated in 1984 with $20,000 in seed money from the Enhancement Account of the Habitat Conservation Fund. Work continued each year up to 1989. Logs were pushed into windrows by a D-6 Cat, air dried for six months and burned on site. It is not anticipated that significant new drift material will enter the site in the foreseeable future. Logging and mill standards have been tightened up, and the Fraser River Debris Trap located between Hope and Agassiz captures most of the natural driftwood load coming down the Fraser each year. However, a significant amount of natural and man-made debris still clogs many foreshore habitats and further improvements must be made to eliminate mill and wood handling debris release. Enhancement work was completed at the site under joint efforts of the Ministry of Environment and Ducks Unlimited. A total of $192,000 was spent. The entire 34 ha cleared has now recovered to productive saltmarsh.

3.2 Manipulation of Water Regimes

Some areas in the estuary which have been historically dyked and drained have been reclaimed to natural tidal action or subjected to controlled levels of flooding. Both of these approaches of manipulating water regimes are intended to create or enhance the production of wetland vegetation and shallow water bodies. The techniques used to achieve this type of habitat restoration and enhancement can be as simple as creating openings in dykes or it can involve the construction of a network of pumps, floodgates, and channels.

3.2.1 Tilbury Slough

The DFO implemented a reclamation project in 1985 that involved breaching a remnant dyke to improve water circulation in the marsh between Tilbury Slough and River Road in Delta. A shear-boom was installed at the mouth of the slough to prevent driftwood from accumulating in the marsh. To improve tidal circulation and flushing in the dyked marsh, networks of drainage channels were excavated and connected to a new opening in the dyke. The restoration work was intended to improve the exchange of organic matter and invertebrates between the slough and the dyked marsh habitat. It would also provide additional rearing and feeding areas for juvenile salmon entering Tilbury Slough. A research study on the Tilbury Restoration Project concluded that dyke removal and channel excavation can achieve a net gain in productive juvenile salmon habitat (Macdonald et al, 1990). In 1990, additional works were therefore completed in an adjacent area.

3.2.2 Ladner Lagoon

Formerly known as Ladner Sewage Lagoon, this area was dyked and put into service in 1963 as a sewage lagoon for the Delta municipality. The lagoon was decommissioned in 1984 and restored for fish and wildlife habitat in 1988-89. Habitat restoration under the supervision and assistance of DFO involved breaching of the dyke and trenching to facilitate the exchange of tidal water with Ladner Slough. The area is now in the process of being transferred to the MOE for inclusion into the Ladner Marsh Cooperative Wildlife Area.

3.3 Creation of New Substrate

Opportunities for creating new intertidal or shallow subtidal substrate in the estuary have thus far been considered only for dredged material disposal. Research and development related to the use of dredged material for habitat creation has been extensively pursued in the 1970's by the U.S. Army Corps of Engineers in their Dredged Material Research Program. In 1980, Public Works Canada conducted a Habitat Development Program in the estuary which identified potential habitat creation sites using dredge spoil as a sub-

strate. Only one experimental application of habitat creation with dredged material has been undertaken thus far (see below).

3.3.1 Steveston Jetty Dredge Spoil Site

Public Works Canada removed, on average, approximately 474,000 m^3/yr of sand from the deep sea navigation channel at Steveston Bend (Steveston North Jetty) over the period of 1975-85. The need to find a suitable spoil site led to the creation of an experimental sand spoil pad in 1987 at Steveston Bend. The objective of the project was to create a stable intertidal habitat suitable for the establishment of marsh vegetation. An earlier attempt to create a stable sand spoil pad failed due to the lack of protective structures to mitigate sand erosion. Even with protective structures, the exposed nature of the site creates uncertainty as to the long-term stability of the habitat. The experimental dredge spoil pad (island) has been monitored since its construction. Monitoring of natural and transplanted vegetation is currently underway.

3.4 Vegetation Transplanting

3.4.1 Fraser River Park

The 6.9 ha Fraser River Park is located at the southern foot of Angus Drive on the North Arm of the Fraser River. The Park, which is administered by the Vancouver City Parks Branch, was developed in 1985-86. Tidal marsh vegetation (mainly Lyngbyei's sedge, cat-tail, and wild Iris) was planted on existing tidal flats which were generally devoid of vegetation. A constructed tidal channel which cuts through the park was planted with cat-tail and bulrush. For the purpose of public park use, the transplanted marsh vegetation added an interesting landscape view. The vegetation transplanting also restored and enhanced the intertidal and riparian zone of the river shoreline.

3.4.2 Coquitlam River Dyking Project

Although outside of the FREMP area, the Coquitlam River bank protection and dyking project is a good example of vegetation transplanting on river dykes. This project incorporated eco-cells, rock groynes, boulder groupings and a fish rearing channel to offset the removal of river bank vegetation and fish habitat. The eco-cell design is an innovative concept which incorporates riparian vegetation into the constructed bank protection works. This environmental engineering design had never been used before in Canada. This Project was part of the joint federal-provincial Fraser River Dyking Program.

4. Conclusions and Recommendations

Recommendations indicated in ***italics*** are considered by the HAWG to be priority items.

4.1 Conclusions

- Habitat restoration and enhancement is a major means of providing for the habitat needs of fish and wildlife.

- There is a lack of an overall plan or strategy for habitat enhancement and restoration in the estuary.

- No comprehensive compilation of potential enhancement and/or restoration projects has been prepared.

- The has been a lack of participation by industry and all levels of government in restoration and enhancement programs. There are positive public relation benefits to be gained in the support and implementation of restoration and enhancement programs.

4.2 Recommendations

- *Degraded habitat areas with high potential for restoration must be returned to their former productivity.*

- *Habitat restoration and enhancement plans must be developed and coordinated by the HAWG successor, which must also ensure that the plans are implemented.*

- The HAWG successor must insure that information on restoration and enhancement projects are kept in a central registry along with information on compensation projects. This will facilitate assessments of the overall habitat status in the estuary.

- The future FREMP must develop arrangements for industry sponsorship and involvement in habitat restoration work; especially with respect to shoreline clean-up efforts.

- The HAWG successor must develop arrangements for more involvement at all levels of government in habitat restoration and enhancement. For example, municipalities could sponsor an "adopt a beach" program to clean-up and maintain river shorelines.

MANAGEMENT PLANS AND PROGRAMS

This report section describes some of the comprehensive plans and programs that have been developed to specifically address habitat management issues in the Fraser River estuary.

1. Habitat Inventory and Classification

One of the first objectives of the Habitat Management Activity Program was to produce a detailed and comprehensive biophysical inventory of habitat types in the Fraser estuary. For this purpose, habitat maps were produced at a scale of 1:2,500 and 1:10,000 covering the entire FREMP area of the estuary. The habitat information contained on the maps was transferred from the best available color airphotos (46 X 46 cm enlargements). The mapped habitat information was also ground-truthed and thus represents the most accurate and comprehensive habitat inventory to-date. The mapped data includes the following habitat categories:

a) Estuarine marsh - sedge, bulrush, cat-tail
b) Riparian vegetation - trees
c) Riparian vegetation - grassy or shrubby banks
d) Intertidal Mudflat - algae, vascular aquatics
e) Intertidal Sandflat - generally unvegetated
f) Developed Shoreline - piers, bulkheads, riprap

Habitats were quantified according to the area (m^2) of marsh and intertidal mudflat and sandflat. A linear measure of the amount of riparian habitat was also included on the habitat inventory maps. As such, the maps highlight habitat in the area of most intensive river use and development; the river shoreline and intertidal flats. However, habitats such as shallow subtidal areas, river channels, sloughs, backshores, as well as water quality considerations are all recognized to be integral parts of the estuarine ecosystem. These habitats are also considered in site-specific assessments.

The Area Designation categories (see Section 2. below) were also added to the maps. In addition to the mapped habitat information, a classification system based on color coding was included on the maps. These color codes (red, yellow, green) classify the river shoreline as to overall habitat value and signify the requirements for future human use and development. Red represents the most productive habitat areas. Development in red areas will not be permitted unless it can be shown that no alteration or alienation to the habitat will occur. Habitat created through compensation measures will be classified as red. Yellow represents moderately productive habitat. Development in yellow areas will be permitted subject to satisfactory habitat mitigation and/or compensation. Green represents areas of low productive habitat. Development in green areas will be permitted subject to environmentally sound design and timing restrictions. Figure 3 provides an example of a color coded map prepared for the North Fraser River Harbour Commission.

For the purpose habitat management and planning, the FREMP area has been divided into 15 habitat management units (HMUs). The size and location of HMUs were determined on the basis of overall geography, existing habitat, and degree of existing and expected human use and development activity.

A summary of the total area of marsh habitat and linear extent of riparian habitat in each management unit is shown in Table 2 and Table 3 respectively.

2. Area Designations

An Area Designation Map was developed during Phase 2 of the Fraser River Estuary Study (FRES 1981). The purpose of Area Designations is to provide a guide to the best use of the estuary based on the estuary's natural attributes and its suitability for human activities. The Area Designation Map is intended to serve as a guideline for preparation of management area plans and a reference for agency decision-making.

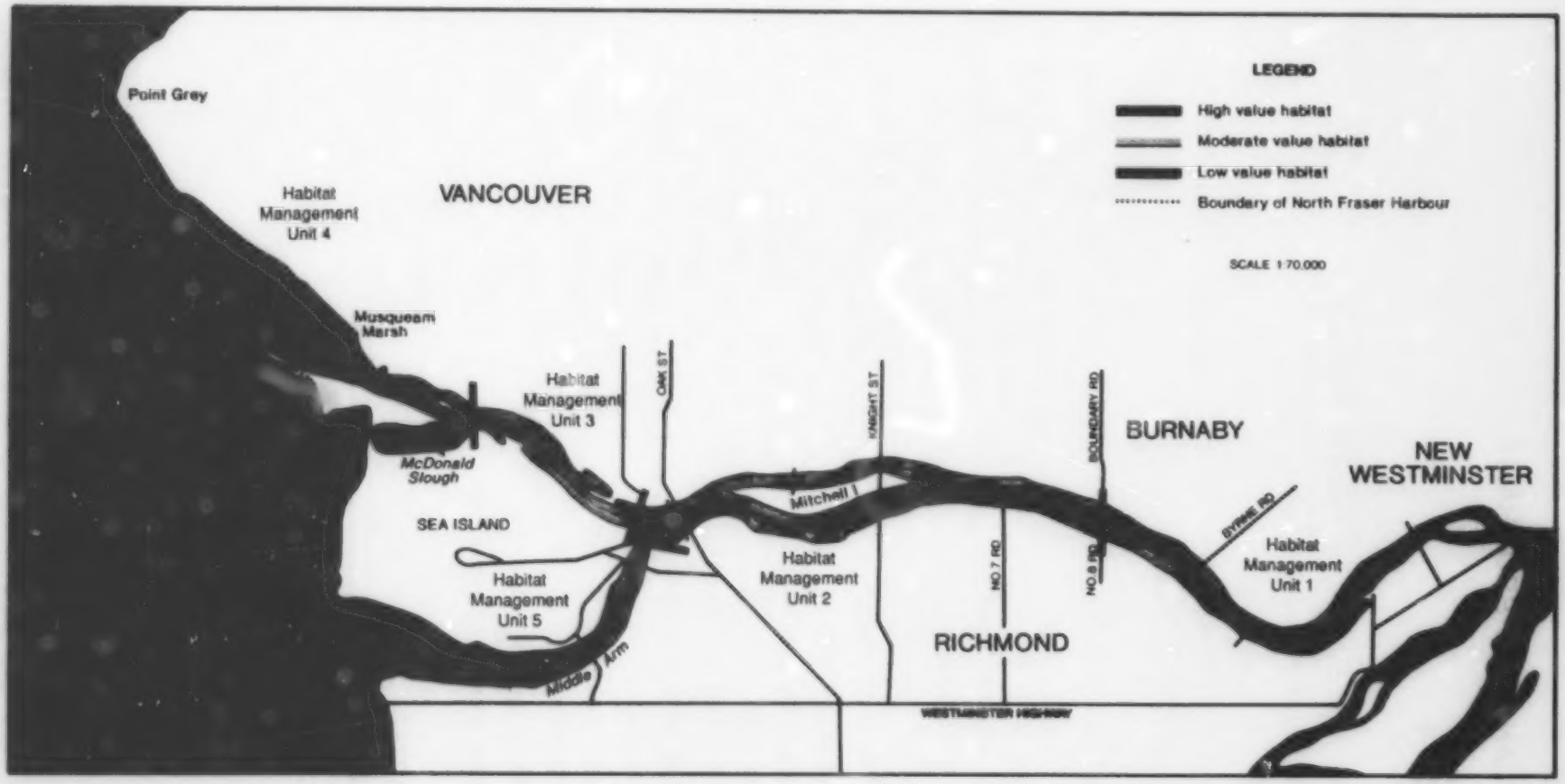

FIGURE 3 NORTH FRASER HARBOUR INVENTORY SHORELINE CLASSIFICATION (FINALIZED DECEMBER 1990)

TABLE 2. Total area of marsh habitat in the Fraser River estuary according to habitat management unit.

Unit No.	Location	Area ha
7	Roberts Bank	1,042
6	Sturgeon Bank	649
9	Steveston to Deas	606
15	Pitt River	447
8	Boundary Bay	177
4	Iona Island	141
10	Deas to Annacis	95
5	Middle Arm	68
14	Douglas to Kanaka	19
11	Annacis Channel	9
2	Marpole Basin	7
3	Sea Island, N. Arm	5
1	Burnaby Big Bend	4
12	Main Arm @ Annacis	3
13	New West. to Douglas	1
	TOTAL	3,273

TABLE 3. Total linear extent of riparian habitat in the Fraser River estuary according to habitat management unit.

Unit No.	Location	Length km
9	Steveston to Deas	39.0
14	Douglas to Kanaka	38.7
15	Pitt River	29.9
10	Deas to Annacis	25.9
8	Boundary Bay	10.3
4	Iona Island, N. Arm	7.3
1	Burnaby Big Bend	7.2
11	Annacis Channel	7.0
12	Main Arm @ Annacis	6.7
2	Marpole Basin	6.5
13	New West. to Douglas	5.5
7	Roberts Bank	5.0
5	Middle Arm	2.2
3	Sea Island, N. Arm	1.8
6	Sturgeon Bank	0.2
	TOTAL	193.2

A task force (Area Designation Task Force) approach was used to arrive, by consensus, at the single use status of different shoreline areas. Where consensus could not be reached, some areas were designated "undetermined use". There were eight classifications in the first draft Area Designation Map.

[C] Conservation
[U] Urban
[R] Recreation/Park
[L] Log Storage
[I] Industry
[P] Port/Terminal
[S] Small Craft Moorage
(now referred to as; Water Oriented Commercial/Residential [W])
[*] Undetermined

Under FREMP, a review and update of the Area Designation Map is currently being implemented. A "Statement of Intent" is being used to achieve more formal commitment to the designations between each municipality, environmental agencies, the Harbour Commissions, and B.C. Ministry of Crown Lands. The Statement of Intent establishes a process for adopting and implementing the Area Designations. It also provides a mechanism for reviewing the designations and for resolving disputes. Prior to adoption, a public review is conducted of the proposed designations.

For many areas of the estuary, multiple use designations may be feasible where compatible activities can be carried out. A new designation category, Water Oriented Commercial/Residential has replaced the Small Craft Moorage designation.

Area Designations provide an important planning tool and help to reduce uncertainty for development in the estuary. They also provide a link between upland zoning (outside of FREMP boundaries) and water related activities. The work of each of the FREMP Activity Programs, such as the Habitat Inventory and Classification Maps, provide valuable information into the determination of the Area Designations.

3. Port Development - Environmental Management Plans

The Environmental Management Plans of the North Fraser Harbour Commission (1988) and the Fraser River Harbour Commission (1990) are intended to facilitate a pro-active approach toward port development and environmental management. These Environmental Management Plans will be carried out using the following procedures:

a) A habitat inventory and shoreline classification system (see Section 2. above);

b) a project review and assessment procedure, which will follow the FREMP coordinated review process (see Chapter I, Section 2.3.1).

c) a habitat banking system (see Chapter II, Section 4.4);

d) a cooperative management program designed to make fish management and fish habitat concerns an integral component of Harbour operations and development planning processes;

e) encouraging compensation or mitigation on proponents' fee-simple land prior to considering Crown Land sites or off-site solutions.

f) encouraging improved harbour keeping practices.

4. Wildlife Area Management Plans

Wildlife Management Plans are prepared by the MOE and CWS for the designation of Wildlife Management Areas or Cooperative Management Areas. The purpose of the Management Plans is to outline plans for the protection and management of the Wildlife Area and to solicit comments from interested groups and individuals. Information con-

tained in the Management Plan includes a general description of the Management Area, the historic and present resource values and land use, specific management goals and objectives, management prescription or policies (and scheduling thereof), legal arrangements, and provision for review of the Plan.

The existing management plan for the Pitt/Addington Wildlife Management Area is currently being revised and updated. For the Sturgeon Bank (MOE in prep.) and the Ladner Marsh Cooperative Wildlife Management Areas (MOE in prep.), management plans are in the draft stage. A management plan is scheduled to be developed for Boundary Bay once the area has been secured as a Wildlife Management Area.

5. Vegetation Management

Commercial harvesting of Sea-Asparagus (Salicornia virginica), regulated and licensed by the B.C. Ministry of Agriculture, amounts to ca. 20 tons, or 0.25% of the total standing stock in the Strait of Georgia salt marshes (Hutchinson and Smythe 1990). The environmental effects of harvesting has recently been under investigation in Boundary Bay. It was concluded that recovery of the Salicornia subsequent to harvesting would be good provided that crop rotation on a two year cycle, and early season harvesting were practiced (Hutchinson and Smythe 1990). At present, harvesting occurs primarily on Vancouver Island, although there has been some interest by commercial harvesters to work in Boundary Bay.

6. Dyke Maintenance

6.1 Tsawwassen Marsh Flood Control

The Tsawwassen Indian Reserve Flood Control Works represent a unique project which incorporated flood control with wetland preservation. The project was initiated under the Canada-British Columbia Fraser River Fl[illegible] Control Agreement (1986) to complete the ring of dykes protecting Delta municip[illegible]y from flooding by the sea. A breakwater with several openings was constructed to permit tidal inundation of the important Tsawwassen

salt marsh habitat. The salt marsh continues to be an integral part of the Roberts Bank tidal flat ecosystem providing detritus-based nutrients, fish-food organisms and a refuge for fish species. The salt marsh also remains a valuable wildlife habitat for waterfowl, shorebirds and large numbers of great blue herons (Bernard and Bartnik 1987)

6.2 Environmental Guidelines

In 1989 a report entitled "Environmental Guidelines for Dyke Maintenance" was published by B.C. Environment, Water Management Branch.

This report was prepared in response to a request by the Fraser River Joint Advisory Board for the development of principles of environmentally sensitive dyke maintenance. Meetings were held with Federal Water Planning and Management, Fisheries and Oceans, B.C. Environment, and Water Management Branch staff. The committee approach resulted in an information exchange so as to better understand the dyke maintenance requirements and the environmental concerns.

Principles have been developed to ensure the dykes are maintained adequately with minimal environmental impact. Research was done to determine dyke maintenance standards and practices in other areas. Also, as a guideline to municipalities and dyking districts, a statement regarding "Approvals Necessary for Dyke Maintenance Activities" has been prepared.

The principles that have been developed will be subject to a three-year trial period to allow for monitoring and revisions if required.

7. Conclusions and Recommendations

Recommendations indicated in *italics* are considered by the HAWG to be priority items.

7.1 Conclusions

- Lack of adequate funding, a shortage of time committed by agency personnel, and insufficient priority allocated toward FREMP activities within agency programs, is identified by the HAWG as a major constraint on the FREMP Habitat Management Activity Program.

- Habitat management tools such as the habitat classification on the Habitat Inventory Maps and the Area Designations are not yet fully accepted and supported by all participants in FREMP.

- Habitat management on lands not currently controlled by wildlife agencies is largely a reaction to specific development projects, or it involves land acquisition based on the best existing opportunities. There is currently no comprehensive habitat management plan for the FREMP area.

- Existing FREMP habitat management activities are restrictive in scope because of the arbitrary boundaries of the FREMP area. Moreover, the habitat management link between aquatic and terrestrial ecosystems in the estuary is weak.

- The existing Habitat Inventory and Classification information is limited to general classification categories and lacks data on vegetation biology.

- Future manipulations of mapped habitat inventory and classification information will be increasingly constrained as the cost and difficulty of manually manipulating mapped data becomes prohibitive and impractical.

7.2 Recommendations

- *Adequate funding and resource committments from participating agencies at all levels of government is a prerequisite for the proper implementation and success of all future FREMP programs and activities. There must be an adequate amount of time allowance for personnel and priority allocation to agency programs so that the HAWG successor can operate more effectively.*

- *Agencies at all levels of government must make a firm commitment to formally adopt and implement the habitat management tools that have been and will be developed.*

- *Habitat management should be based on a proactive, estuary-wide plan that takes into account the complete inventory and classification of habitat. Administrative and working-level linkages must be established with other programs and planning efforts which affect habitats in the estuary.*

- Future FREMP habitat management plans must cover all geographic and functional aspects of the ecosystem that effect the estuary's habitat. Specifically, there is a need to strengthen the habitat management linkage between aquatic and terrestrial ecosystems in the estuary. Consideration must be given to strengthening the relationship and coordinated planning between FREMP and municipalities on water oriented developments.

- The Habitat Inventory and Classification maps must be upgraded by the HAWG successor to include information on the occurrence and abundance of dominant plant species. The maps should then be updated every five years.

- Future revisions to the Habitat Inventory and Classification maps would be greatly facilitated if the maps were managed in a GIS or computer mapping system.

- The development of a habitat management plan by the HAWG successor is an essential component of the overall estuary management plan that will be developed by the future FREMP.

PUBLIC AWARENESS

This chapter describes programs and activities enabling the public to participate in various facets of habitat management of the Fraser River estuary. Public participation in habitat management of the estuary is directed mainly toward habitat conservation, enhancement, and environmental education. The following examples describe some of the programs and opportunities available for the public to become directly involved in habitat management of the Fraser River estuary.

1. Storm Drain Marking Program

The Storm Drain Marking Program (SDMP) is an example of how the public can become actively involved in addressing an environmental issue that effects aquatic habitat. The Program is a cooperative effort between the MOE, DFO, and the GVRD. The SDMP essentially creates public awareness about the detrimental effect on fish habitat related to the disposal of hazardous household products into storm drains. The public can also become directly involved in this issue by voluntarily marking a yellow fish symbol beside storm drains that discharge into local streams. This fish symbol reminds neighborhood residents that if they permit toxic substances to enter marked storm drains they may be poisoning fish in a nearby stream. Many of these streams in the Lower Mainland flow into the Fraser River estuary.

2. Environmental Partners Fund

The Environmental Partners Fund is a federal government initiative which has set aside $50 million over five years to help local groups take action in protecting, preserving, enhancing and restoring the environment at the community level. The Partners Fund is a way to stimulate partnership and, encourage individuals to get personally involved in cleaning-up the environment through local community-based organizations.

Only non-governmental, non-commercial groups are eligible for applying to the fund. Supporting partners such as industry, local business, environmental groups and trust

foundations, and municipal governments may provide financial and other assistance.

Innovative, action-oriented projects that protect, preserve, improve and restore the environment are eligible. Projects should improve the local environment while encouraging the development of supportive partnerships from within the community.

Potential habitat projects could include:

- rehabilitating and cleaning up river shoreline areas;
- restoring fish and wildlife habitats;
- conserving local water supplies

3. B.C. Wildlife Watch

Wildlife Watch is a Wildlife Viewing Program (WVP) directed by the Wildlife Program of the MOE. The intent of the WVP is to encourage public understanding and appreciation of wildlife, fish and habitat in British Columbia. It is an inter-agency initiative designed to promote recreational, educational and commercial opportunities to view wildlife and fish in their natural habitats. Viewing opportunities will be developed at a number of sites on the Fraser River estuary, i.e. Ladner Marsh, Serpentine, Pitt/Addington Marsh, Boundary Bay, Roberts Bank, and Sturgeon Bank.

4. Regional Festivals

Regional Festivals and Display Centers offer the public and opportunity to obtain information about habitat related issues first-hand from representatives of government agencies and conservation groups. In addition to enhancing public awareness and education, festivals and displays also provide opportunities to inspect the tools and procedures used to study and manage the estuary's habitats.

4.1 Fraser River Festival

The Fraser River Festival has been held each year since 1988 on the first Sunday in June at the Deas Island Regional Park. The Festival is co-sponsored by FREMP, GVRD Parks, DOE, and the Council of Forest Industries. There are a number of government agencies (e.g MOE, DFO, EP, IWD, CWS) with displays showing various aspects of habitat management. Numerous Naturalist and Conservation Groups are also represented. Activities on Deas Slough and the Fraser River shoreline give the public an opportunity to learn about the habitat from naturalists leading the tours.

The Festival also provides an opportunity to present awards for outstanding environmental achievements by government and private organizations. The Industrial/Commercial Development Award recognizes good environmental design and implementation, and cooperation with the FREMP, by a private sector company. The Conservation Award recognizes significant contributions made to conservation efforts in the estuary.

4.2 Fraser Fest

The Fraser Fest was held for the first time in July of 1990 at the New Westminster Public Market. The Festival is co-sponsored by the Fraser River Discovery Centre (Section see 5.1 below) and the Hyack Festival Organizing Committee. The Festival was also run in conjunction to the Fraser River Work Boat Parade. The orientation of the Festival is around commercial and industrial interests. However, representatives from the DFO, MOE, and FREMP were on hand to offer information and displays related to the Fraser River estuary habitat.

4.3 Snow Goose Festival

Each year since 1986, the CWS has co-sponsored a Snow Goose Festival to give the public an opportunity to observe and enjoy, at close hand, overwintering Snow Goose populations. The B.C. Waterfowl Society and Ladner Business Association are involved in organizing and coordinating the Festival. The Festival is held at the Alaksen National Wildlife

Area. Staff from the CWS are available to offer technical information about the snow geese and their habitat. There is also a display area describing some of the research projects the CWS is involved in.

5. Interpretation Centres

5.1 Fraser River Discovery Centre

The Fraser River Discovery Centre Society is a non-profit organization comprised of an honorary and working board of directors, and an advisory committee whose goal it is to develop and build a Fraser River Discovery Centre (FRDC). The planned FRDC will serve as a major public education and interpretation centre covering all aspects (e.g. commerce, industry, transportation, environment) related to the lower Fraser River and estuary. The environment and habitats of the estuary will be an important theme addressed by the Centre. The FRDC is planned to have a river-front location in the estuary (probably in New Westminster), where it will occupy about 50,000 square feet of floor space.

5.2 Interpretive Signage

Several locations in the estuary provide signs describing local geographic, historic, and habitat features. Deas Island Park and Reifel Refuge have a centralized display of large signs. Individual smaller signs are also scattered along the north western dyke of Lulu Island (Richmond).

6. Environmental Conservation Organizations

A number of public and private organizations, many of which have a priority interest in the Fraser River estuary, are capable of supporting environmental issues related to habitat management. A current listing of environmental conservation organizations is available in the directory issued by the B.C. Environmental Network (1990). Copies of this and other directories are available from Will Paulik of the Fraser River Coalition.

7. Conclusions and Recommendations

Recommendations indicated in *italics* are considered by the HAWG to be priority items.

7.1 Conclusions

- The potential exists to improve public participation, education, and awareness with respect to habitat in the estuary.

- There is currently no central, public interpretive resource facility to provide an overview of information on the Fraser River estuary.

7.2 Recommendations

- *The opportunities for public involvement in the various environmental review processes must be improved by better advertisements of project proposals and by the Environmental Review Committee (ERC) issuing an annual report.*

- *A Public Interpretive Resource Facility is needed for the Fraser River estuary. The Fraser River Coalition should spearhead the development of a centralized interpretive facility with a focus on public information, education, communication, etc., dealing with issues related to the Fraser River estuary. The public interpretive facility (or "estuarium") could serve as a meeting place for public groups committed to estuarine enhancement, a public information and dissemination center, and a staging area for controlled access to adjacent marsh rehabilitation demonstration area(s).*

- The centralized facility could be used to hold annual public meetings to discuss FREMP Habitat Activities and Plans. Public workshops or forums could also be used to involve the public in the future development of FREMP, in the environmental review of significant projects, or in help and advise on habitat restoration and enhancement projects.

- An ad-hoc or standing committee must be formed to directly deal with public awareness and communication related to FREMP activities and issues.

WORKSHOP RESULTS

This chapter presents the results of the FREMP Habitat Workshop held at the North Fraser Harbour Commission in Richmond B.C. on June 27 and 28, 1990. The workshop was sponsored by the Fraser River Estuary Management Program (FREMP) and was one of the program components of the FREMP Habitat Activity Work Group.

The workshop brought together local researchers and managers qualified and experienced in assessing and discussing habitat issues of the Fraser River estuary. To encourage a good dialogue and interchange of ideas, the number of participants was limited to 23. Individuals were invited from government agencies, university, consulting firms, and public groups.

The main goal of the workshop was to identify and discuss perceived deficiencies in habitat research and to recommend ways of dealing with these. To achieve this goal, several key habitat topics were discussed and three basic questions were posed: 1. What is our present knowledge?, 2. Where are the deficiencies?, 3. How can we improve this knowledge?

The following information describes the recommendations made by the workshop participants. Some of these recommendations may also be included in previous chapters of this report. However, the HAWG wanted to present the original and complete list of recommendations that came out of the workshop. The results of the workshop have also been published as a separate Proceedings (FREMP 1990).

Recommendations indicated in *italics* are considered by the HAWG to be priority items.

1. Inventory and Classification

Refine Information Describing Vegetated Habitats.

The existing Habitat Inventory Maps show six general habitat classifications on maps of 1:2,500 or 1:10,000 scale. More detailed information is needed to characterize and map marsh systems. Future habitat inventories should include information such as percent plant cover, and composition of indicator species. Some of this information may already be available in the 1979-80 Fraser River Inventory (FRI) database; however, these data may be difficult to access because of their electronic storage format.

Let User Needs Dictate Classification Schemes

Existing habitat inventories and maps are adequate for the purpose for which they are currently being used. However, it is suggested that the objectives of the inventory and the end users are clearly identified to make sure that information provided is specifically tailored to the needs of the user.

Temporal and Spatial Mapping Scales

One of the objectives of habitat inventory mapping is to determine temporal trends in habitat. Existing habitat inventories, or portions thereof, should be repeated approximately every five years. The best mapping scale presently available (ie. 1:2500) is adequate for the level of detail currently required.

Digitized Mapping Information

The present habitat inventory maps will eventually have to be digitized to afford greater flexibility through computer mapping or GIS. This will greatly facilitate regular updating and enhance interaction with user groups.

Ownership Status of Habitats

Habitat inventory and mapping should include and monitor the ownership status of habitats in the Fraser River estuary.

Habitat Compensation Sites

Habitat inventory and mapping should also include all habitat compensation, restoration, and enhancement sites.

Habitat Classification

The discrepancy in areas of apparently the same habitat type reported by different authors is partly attributed to variations in defining and classifying habitat types. It is therefore recommended that a standard or consistent classification scheme be adopted for habitats in the Fraser River estuary.

Habitat Erosion and Accretion

The net loss and net gain of habitat should be thoroughly assessed, and reassessed in five year increments. The habitat assessment and accounting of habitat erosion and accretion should include an examination of causal factors. Compensation, restoration and enhancement sites should be included in the assessment.

2. Ecological Functions: Fish

Functions and Values

Habitat research should address a broad spectrum of functions and values beyond fish rearing and feeding to include, for example, water quality, substrate stability, etc..

Distributional Patterns of Juvenile Salmon

Further study was recommended on the cross channel distribution of juvenile salmon. Others suggested that a considerable amount of useful information already exists on this topic.

Ongoing Research Project

A particular river reach should be selected where ongoing ecological research can be undertaken on fish/habitat relationships. Various integrated research projects should be undertaken in this "audit reach" or "habitat science reach" as it was termed by some of the workshop participants. The study area should be free from development except for experimental purposes.

Information Transfer

As an alternative to undertaking site-specific research projects, it is recommended that information from other estuaries be examined as to its applicability to the Fraser River estuary. The merits of this approach would probably need to be evaluated on a topic-specific basis.

Ecologically Important Fish Species

Most of our research focuses on only a small percentage of the total number of fish species present in the estuary. The economically important species typically are the subject of study. Some effort should also be made to study other, non-economically important fish species. This would address some important questions about the ecological role of fish species and the importance of fish species diversity in the estuary and provide more valid and useful information regarding environmental contaminants. Less work is being done now on this research topic than in past decades.

Funding Sources

To overcome the chronic shortage of research funding, it is recommended that several creative ideas should be pursued. Some of these ideas included surcharges (environmental taxes) on shoreline industries, the formation of a Fraser River Estuary Research Foundation, and a University Fraser Estuary Research Centre or Program.

Function of Habitat Compensation Sites

There has been little research and monitoring at habitat compensation sites. Therefore, at this time it is difficult to determine whether fish are benefiting from habitat compensation sites and how these sites function over time. Habitat compensation sites should be treated more formally as an experiment, with a proper control site and long term monitoring.

Information Clearing House

A centralized information clearing house is required where all research undertaken in the Fraser River estuary is registered in a computerized system. This information should then be easily accessible to anyone with research interests in the Fraser estuary.

3. Sea Level Rise and Estuarine Wetlands

Habitat Management

A sand deficit exist in the outer estuary due to dredging activities and river training. Marshes are therefore no longer accreting as rapidly as they were during the last century. Also, with rising sea levels, foreshore marshes will completely disappear because dykes will prevent their inland development.

The time scale for habitat management needs to be broadened to 50 or 100 years to encompass concerns about sea level rise and habitat losses. For example, sediments could be redistributed from deep water to build up areas which will be flooded in the future.

4. Ecological Functions: Birds

Environmental Contaminants

Further research is needed on how environmental contaminants move through the estuarine food chain up to birds. Toxic contaminants in the Great blue heron are at higher concentrations than what uptake from feeding would predict. More information is required on the sources, transport, and fate of contaminants in the heron's food chain.

Habitat Compensation

The displacement of existing bird populations through the acquisition of new habitat areas is an important aspect of habitat compensation. The significance of land acquisition such as farmland to compensate for lost habitat should be studied.

Another aspect of habitat compensation is the role of fish habitat compensation sites in the ecology of estuarine birds. Bird use of an area should be monitored before and after a habitat compensation site is developed to compare man-made to natural habitat use.

GVRD Open Space Policy

The need for natural open areas, parks, and agricultural lands in the Fraser River estuary to serve as bird habitat should be tied into regional municipal planning.

University Research

It was noted that SFU will be starting a Wildlife Ecology Research Program. Research on the function of the Fraser River estuary to birds migrating north and south should be part of this research program.

Bird Energetics

Research needs to be undertaken on bird energetics especially as it relates to feeding during migration and breeding.

Ongoing Research Project

Bird ecology should be part of any integrated research project undertaken in a so-called "audit reach" of the Fraser River estuary. The important environmental factors controlling the distribution of different bird species need to be studied. Critical habitat criteria, especially food supply, needs to be related to bird use.

Auditing and Monitoring of Habitat

The temporal patterns of habitat use by birds need to be studied. The question of whether bird populations in the Fraser estuary are at carrying capacity, or how much land is needed can only be addressed through long-term monitoring studies. There is also a need to utilize monitoring data in rigorous data analyses and objective interpretations to develop forecasts and models.

5. Integration of Water Quality and Physical Habitat

Sub-lethal Criteria

Recent research results should be used to establish sub-lethal criteria for fish. Studies should be undertaken to determine if these sub-lethal criteria can be used to protect fish. Also, more data are needed to develop a baseline of physiological stress criteria for key indicator species in the estuary and to relate these to survival.

Fish Population Studies

In situ toxicity studies should be coupled with population studies by following the fate of tagged and exposed fish. Studies need to be designed which can address the effects of chronic exposures to contaminants on the health, fitness, and reproduction of fish populations.

Biomonitoring

Fish food organisms should be studied to determine their body burdens for environmental contaminants. Certain benthic species should be selected to serve as bioindicators of food web contamination in the Fraser River estuary.

Toxic Contaminants in Migrating and Resident Fish

More comprehensive information is needed on toxic contaminant levels in sport fish, commercial fish, and especially bottom fish.

Role of Aquatic Plants in Water Quality

Experimental evidence reported in the literature suggests that aquatic plants can act as a biofilter, capable of removing metals and toxic organic contaminants from polluted water. The role of marsh habitat in the overall water quality of the Fraser River estuary should be investigated.

Total Pollution Loading

Studies aimed at linking water quality and habitat should include the total or cumulative effects of all pollutants in and entering into the estuary. This approach would also address the question of whether present water quality conditions are significantly influencing and restricting the quality of habitat available to fish and wildlife. Furthermore, the issue of optimal vs tolerable water quality conditions needs to be addressed in aquatic organisms.

6. Compensation and Restoration

Physical Stability

Few habitat compensation projects thus far have studied physical stability for a period prior to transplanting. Physical site stability should be addressed prior to restoring or creating habitat areas.

Experimental Controls

Experimental designs should include a control site which is used as a reference to a habitat creation or restoration site. Successful achievement of habitat compensation can then be properly compared to baseline conditions in terms of primary production, species diversity and abundance, and fish and wildlife use. Experimental designs should include studies of the faunal components of the ecosystem (ie. benthos, fish, birds).

Detritus and Belowground Biomass

Assessments of different potential transplant species should include studies of belowground biomass as well as the flux of dead plant tissue (phytodetritus).

Upland Habitat

Restoration and creation projects should actively pursue the prospects for upland habitat. Winter crops are currently being managed for bird use at the Alaksen National Wildlife Area. Further studies are being undertaken to apply crop management to other agricultural areas. The opportunities for restoring areas of agricultural land to secondary succession grassland, wetland, or bottomland forest should also be pursued.

7. Area Designations

Public Input and Access Rights to Foreshore

Problems with public access to a number of popular shoreline sites are recognized. Since municipalities control the majority of land, they should be encouraged to get involved in the process of developing access rights to foreshore areas of the Fraser estuary.

FREMP Boundaries

Concern was expressed about the protection of upland habitat, especially for bird use. However, it was noted that unless there is a change in the geographic jurisdiction of FREMP, it is not able to adequately manage for the protection of important fish and wildlife habitat outside of the FREMP area. Efforts should be undertaken to address this deficiency.

Standardized Municipal Zoning

The environmental rationale of some municipal zoning categories were considered questionable. Environmental zoning and conservation designations are needed to make some existing zoning categories standard and consistent across the whole estuary.

Net Gain in Habitat

An overall plan should be developed to provide a net gain in the quantity of habitat over time. To achieve this goal, habitat mitigation should take priority over habitat compensation. A vigorous habitat restoration and enhancement program should be implemented. Also, the distribution of habitat gains throughout the estuary should be carefully planned to prevent an unbalanced distribution of habitat.

Public Awareness

An Environmental Interpretation Centre is needed for the Fraser estuary. This need has been addressed by two proposals. A Fraser River Discovery Centre is being proposed by a non-profit Society of the same name, to be located on the New Westminster waterfront. The Richmond Rod & Gun Club supports the establishment of an Estuarium to be located on present municipal property at the south foot of No. 2 Road in Richmond. The need for public education should also be addressed through the provision of appropriate literature and school curricula. Regular school field trips led by knowledgeable individuals should be part of the curriculum of lower mainland schools.

8. Sustainable Development

Integrated Resource Management

A holistic management plan is needed which takes into account all watershed users of the entire Fraser River basin. The Fraser River basin should be managed in a coordinated framework similar to FREMP but upgraded and improved upon.

Short-term Action Plan

The following five action items are needed in the short-term: 1. public education and awareness, 2. convert public concerns into government action, 3. water quality protection, 4. agency cooperation and planning, and 5. enforcement.

Long-term Action Plan

The following three action items are needed in the long-term: 1. a federal - provincial environmentally sustainable basin development plan, 2. planning and development within natural limits, and 3. recognition of basin and globally related issues.

9. Final Synopsis

Ecological Approach

Research and management must address all components of the estuarine ecosystem. Ecosystem research in the estuary must inevitably address basin wide issues and concerns.

Multi-agency Approach

Ecological research and management must be undertaken as a cooperative effort amongst the various government agencies, and other groups and organizations. FREMP should use its coordinating role to organize multi-agency research projects. For this purpose, FREMP should have a Standing Committee on Estuary Research.

FREMP Profile

In order for FREMP to execute some of the recommendations made by the workshop, FREMP will require a much improved status and profile. Some suggestions were: additional staff positions, a more conspicuous office, more professional networking, and increased public awareness.

Species Interactions from Enhanced Stocks

The DFO has made significant gains in rebuilding certain stocks of fish and are continuing to do so. Therefore, the ecological effects of producing larger runs of particular salmon stocks on other fish and wildlife species of the estuary should be addressed.

Social Objectives of Watershed

The environmental and social goals and objectives of human communities occupying the watershed need to be identified and characterized.

Habitat Workshop

The habitat workshop the results of which are reported in this appendix was the first of its kind since 1978 (Fraser River Estuary Study Steering Committee 1978).

A regular meeting should be held, perhaps each year, to discuss habitat issues and concerns. Meetings or workshops could be organized into specific work groups or topics. Information flow between the different FREMP work groups should also be facilitated at the workshops. Other disciplines not included in this workshop should be included in the future (geophysical, chemical). A conference could be combined with a workshop. A public workshop could also be included.

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APPENDIX 1. ACRONYMS

CWA	Cooperative Wildlife Area
CWS	Canadian Wildlife Service
DFO	Department of Fisheries and Oceans
EARP	Environmental Assessment Review Process
EC	Environment Canada
FREMP	Fraser River Estuary Management Program
FRHC	Fraser River Harbour Commission
GVRD	Greater Vancouver Regional District
HAWG	Habitat Activity Work Group
HCF	Habitat Conservation Fund
HMAP	Habitat Management Activity Program
HMQ	Her Majesty the Queen
MCL	Ministry of Crown Land
MOE	Ministry of Environment
MOTH	Ministry of Transportation and Highways
NFHC	North Fraser Harbour Commission
NWA	National Wildlife Area
TNT	The Nature Trust
WMA	Wildlife Management Area

APPENDIX 2.
STATUS OF IMPORTANT HABITAT AREAS IN THE FRASER ESTUARY
(prepared by B.C. ENVIRONMENT, September, 1991)

PROPERTY NAME	SIZE ha (approx)	LAND OWNER	LAND MANAGER	CURRENT SEC. 101 APPLIC'N	EXISTING SEC. 101 STATUS	FUTURE SEC. 101 APPLIC'N	EXISTING WMA STATUS	FUTURE WMA STATUS	HABITAT ENHANCEMENT ACTIVITIES
1. Semiahmoo Bay	390	CP	MCL			X		X	- none anticipated
2. Blackie Spit	65	M. Surrey	M. Surrey					X	- municipal park
3. Boundary/Mud Bays									
a) L. 495	59	Consortium	MOE					X	- none anticipated
b) L. 505	10	B/N RR	B/N RR						- possible purchase, lease or memorandum of understanding
c) Highway 99 R/W	65	CP	MOTH			X			- possible administration and control or lease
d) Grauer Beach									
i) MOE	55	CP	MOE		X			X	- log debris removal
ii) TNT(PECP)	32	TNT	MOE					X	- log debris removal
iii) CWS	24	CWS/MOT	CWS					X	- log debris removal
iv) VanDongen	16	CP	MCL			X		X	
e) Boundary/Mud Bay rem.	5685	CP	MCL	X				X	- protection of biologically significant habitat above the zero tide elevation
f) Serp. Wildlife Area	131	CP	MOE	X				X	- public use facilities, internal dyking, water control, soil scarification, agricultural crops
4. Roberts Bank									
a) Brunswick Point	390	CP	MCL			X		X	- none anticipated
b) Westham Island Marshes	1166	CP	MCL			X		X	- none anticipated
c) "Alaksen N.W.A." area	780	CWS	CWS						- as per CWS plans
d) Roberts Bank rem.	2493	CP	MCL			X		X	- protection of biologically significant habitats
5. Sturgeon Bank									
a) Garry Point	30	Richmond	Richmond						
b) Shady (Steveston) Island	15	Fed.	DPW, FRHC						
c) CBC property/towers	16	CBC	CBC						

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d) MOE intertidal	158	CP	MOE/CWS		X			X	- possible log removal & public use facilities
e) Grauer Family holdings	50	private	private					X	- if purchase negotiated at some future date
f) Swishwash Island	50	private	private					X	- if purchase negotiated at some future date
g) Iona Island/Jetties	250	CP	GVRD						
h) Sea Island foreshores	400	CP	MCL						
i) Sturgeon Banks rem.	6990	CP	MCL						
6. Poplar Island	16	private	private						
7. South Arm Island Complex									
a) Duck, Barber, Woodward	569	CP	MOE		X		X		- none anticipated
b) Rose, Kirkland Island	112	TNT	MOE				X		- waterfowl food crop production
c) Gun, Williamson, Frenchie	130	private	private					X	- if purchase negotiated at some future date
d) Ladner Marsh	117	CP	MOE/CWS		X		X		- wildlife viewing facilities, log removal, reg. succession reversal proposal
e) Ladner Lagoon	12	CP	MOE	X			X		- wildlife viewing facilities, SEP project
f) Ladner Harbour Park	5	M.Delta	M.Delta						
g) Ladner Fed. Fish Dock	5	Federal	M.Delta						
h) C. Cove foreshore, Green Slough	5	CP	MCL,FRHC			X		X	- none anticipated
8. Deas Island/Slough foreshore	50	GVRD,CP	GVRD,FRHC						
9. Savage (Tilbury) Bar	30	CP	FRHC			X		X	- none anticipated
10. Tilbury Slough/Marsh	15	Federal	DFO						
11. Chatterton Marshes	13	CP	FRHC			X		X	- none anticipated

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12. Don and Lion Island	15	private	private					X	- if purchase negotiated at some future date
13. Annacis Island Marshes	30	CP, priv.	FRHC, priv.,DFO					X	- none anticipated
14. Burns Bog	3500	private	private					X	- if purchase negotiated at some future date
15. Sapperton Island/Wing Dam	65	HMQ	FRHC					X	- none anticipated
16. Coquitlam R. Marshes									
a) river mouth	16	CP	MCL		X			X	- public use facilities, wood duck nest boxes erected
b) Tree Island	9	private	private					X	- none anticipated
c) Essondale Island	1	CP	MCL			X		X	- none anticipated
d) dykes, riverbed, sheep paddocks	38	CP	BCEC/MCL			X		X	- public pedestrian access
17. Douglas Island									
a) uplands	180	private	private					X	- if purchase negotiated at some future date
b) riverine marshes	10	HMQ	FRHC			X		X	- none anticipated
18. Pitt River Marshes	375	HMQ	FRHC			X		X	- none anticipated
19. Goose Island, Debouville Slough	130	CP	FRHC			X		X	- none anticipated
20. Silver Valley Estates	1100	private	private					X	- if purchase negotiated at some future date
21. Widgeon Creek	260	CP,HMQ	MCL,FRHC			X		X	- none anticipated

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22. Pitt/Addington W.M.A.									
a) east of Pitt River	1485	CP	MOE		X		X		- public use facilities, internal dyking, nesting islands, scarification/smart-weed production, wood duck nest boxes, protection of cottonwood trees from beaver damage, water control structures
b) Addington Point Marsh	263	TNT/HMQ	MOE/FRHC		X		X		
c) Pitt Lake Marshes	1137	CP	MOE		X		X		
23. Surrey Bend									
a) GVRD	180	GVRD	GVRD					X	
b) CNR	80	CNR	CNR						
c) private holdings	200	private	private					X	- if purchase negotiated
d) foreshore marshes, creek	15	HMQ	HMQ/FRHC					X	
24. Barnston Island									
a) riverine marshes	30	HMQ	FRHC						
b) agricultural lands	600	private	private						
25. Derby Reach									
a) uplands	120	GVRD, priv.	GVRD, priv.						
b) riverine marshes	20	HMQ	FRHC						
26. Kanaka Creek									
a) uplands	375	GVRD	GVRD						
b) riverine marshes	130	GVRD,HMQ	GVRD,FRHC						